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GOVERNMENT OF THE PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

REPORT TO

THE LIEUTENANT GOVERNOR IN COUNCIL

With Respect to the Application

Under

The Gas Resources Preservation Act, 1956

of

Foothills Pipe Lines Ltd.

June, 1961

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TABLE OF CONTENTS

		Page
	Introduction	1
	The Application of Foothills Pipe Lines Ltd	3
	Interveners	9
	The Basis of Consideration	16
	FINDINGS	
	In the Matter of	
I	The Future Production of Natural Gas Liquids in Alberta	22
II	The Present and Future Requirements of Alberta for Natural Gas Liquids	23
III	The Present and Future Requirements of Areas in Canada Adjacent to Alberta for Propane	24
IV	Meeting the Present and Future Requirements of Alberta and Adjacent Areas in Canada for Natural Gas Liquids and the Resulting Surplus of Natural Gas Liquids	24
V	The Maximum Quantity of Surplus Natural Gas Liquids Which Might Become Available to Foothills	26
VI	The Applicant's Ownership of or Contracts for the Purchase or Transportation of Propane or Butanes Produced in Alberta	27
VII	The Proposed Tariffs, the Economic Feasibility and the Financibility of the Westalta Main Line and the Foothills-Dakota-Eastern System	28

		Page
VIII	Alternate Means for the Export of Natural Gas Liquids, the Effective Utilization of the Oil and Gas Resources of the Province and the Public Interest.....	28
IX	The Disposition of the Application of Foothills.....	29

APPENDICES

A	The Present and Future Production and the Reserves of Natural Gas Liquids in Alberta.....	A-1
B	The Present and Future Requirements of Alberta for Natural Gas Liquids.....	B-1
C	The Present and Future Requirements of Areas in Canada Adjacent to Alberta for Natural Gas Liquids.....	C-1
D	The Manner in Which the Present and Future Requirements of Alberta and Adjacent Areas in Canada, for Natural Gas Liquids May be Met, and the Resulting Surpluses.....	D-1
E	The Quantity of Surplus Natural Gas Liquids Which Might Become Available to Foothills.....	E-1
F	Economic Feasibility of the Applicant's Scheme.....	F-1
G	General Considerations.....	G-1

LIST OF TABLES

Table		Following
A-1	Forecast of Propane Production From Established Gas Reserves.....	Appendix A

Table		Following
A-2	Forecast of Butane Production From Established Gas Reserves.....	Appendix A
A-3	Forecast of Pentanes Plus Production From Established Gas Reserves.....	"
A-4	Production Forecast of Natural Gas Liquids From Established Reserves.....	"
A-5	Comparison of Natural Gas Liquids Production Forecast As Prepared By The Board And By Various Applicants.....	"
A-6	Production of Natural Gas Liquids From Gas Reserves Not Yet Discovered.....	"
A-7	Comparison Of Production Forecasts For Natural Gas Liquids From Gas Reserves Not Yet Discovered.....	"
A-8	Recoverable Reserves Of Natural Gas Liquids.....	"
B-1	Forecasted Trend In The Consumption Of Propane On Alberta Farms.....	Appendix B
B-2	Forecasted Trend In Alberta Consumption Of Propane As a Principal Heating Fuel In Non-Farm Rural Dwellings	"
B-3	Forecasted Trend In Alberta Consumption Of Propane By Domestic And Commercial Users.....	"
B-4	Domestic And Commercial Demand For Propane-Alberta - 1961-72.....	"
B-5	Forecasts Of Propane Requirements For Alberta - 1961-1990.....	"
B-6	Forecasts Of Propane Requirements For Alberta And Fringe Markets - 1961-1990....	"
B-7	Forecasts Of Butane, Iso-Butane And LPG Mix Requirements For Alberta - 1961-1990.....	"
B-8	Oil and Gas Conservation Board Estimates Of LPG Requirements For Miscible Flooding In Alberta - 1961-1990.....	"

Page		Following
B-9	Forecasts Of Condensate And Natural Gasoline (Pentanes Plus) Requirements For Alberta - 1961-1990.....	Appendix B
C-1	Estimated Domestic and Commercial Requirements For Alberta Propane - Fringe Markets in British Columbia and Saskatchewan.....	Appendix C
E-1	Estimated Movement of Natural Gas Liquids by Existing Transportation Means and the Proposed Hudson's Bay Pipe Line.....	Appendix E
E-2	Estimated Surplus Natural Gas Liquids Available to Foothills.....	"

LIST OF FIGURES

Figure		Following
A-1	Anticipated Future Reserves.....	Appendix A
A-2	Map of Alberta Showing Location of Natural Gas Liquid Reserves.....	"
B-1	Forecast of Alberta Propane Requirements.....	Appendix B
B-2	Forecast of Alberta Butanes Requirements.....	"
C-1	Map of Alberta Showing Fringe Marketing Areas.....	Appendix C
D-1	Propane Production and Requirements - Minimum Plant Recovery.....	Appendix D
D-2	Propane Production and Requirements - Maximum Plant Recovery.....	"
D-3	Propane Surplus - Minimum Plant Recovery.....	"
D-4	Propane Surplus - Maximum Plant Recovery.....	"

Figure		Following
D-5	Butanes Production and Requirements - Minimum Plant Recovery.....	Appendix D
D-6	Butanes Production and Requirements - Maximum Plant Recovery.....	"
D-7	Butanes Surplus - Minimum Plant Recovery.....	"
D-8	Butanes Surplus - Maximum Plant Recovery.....	"
D-9	Production and Requirements - Pentanes Plus.....	"
D-10	Surplus - Pentanes Plus.....	"
F-1	Map of Alberta Showing Location of Natural Gas Liquid Reserves - Existing Crude Oil Lines - Existing Natural Gas Liquid Lines - The Proposed Westalta Products Pipe Line Ltd. Integrated Gathering System.....	Appendix F
F-2	Map of Certain Existing Crude Oil Lines and Proposed Natural Gas Liquids Lines.....	"

D-2 Maximum Flight Recovery ..... "
D-3 Maximum Flight Recovery ..... "
D-4 Maximum Flight Recovery ..... "
D-5 Maximum Flight Recovery ..... "
D-6 Maximum Flight Recovery ..... "
D-7 Maximum Flight Recovery ..... "
D-8 Maximum Flight Recovery ..... "
D-9 Maximum Flight Recovery ..... "
D-10 Maximum Flight Recovery ..... "

I N T R O D U C T I O N

The application of Foothills Pipe Lines Ltd. for a permit or permits under The Gas Resources Preservation Act, 1956, was heard by the Board on October 4 to 7, 1960. Subsequently, the Board approved an application by Foothills Pipe Lines Ltd. to reopen the hearing for the purpose of hearing representations as to variations in the arrangements made with respect to certain matters referred to at previous hearings, and to hear these representations sat on seven days between February 7 and 22, 1961.

The products the applicant proposed to remove from the Province are natural gas liquids consisting of propane, butanes and condensate* recovered from gas at gas processing plants. A permit under the Act would be required only for the removal of the propane and butanes.

Between May 30, 1960, and May 2, 1961, the Board held a number of hearings concerning applications for permits under The Pipe Line Act, 1958, to construct pipe lines for the transportation within the Province of natural gas liquids. The applicants for pipe line permits were Westalta Products Pipe Line Ltd., Britamoil Pipe Line Company Limited, Provincial Products Pipelines Limited, Hydrocarbons Pipeline Limited, Hudson's Bay Oil and Gas Company Limited, and Royalite Oil Company, Limited. The companies which were represented at the

* Not defined by Foothills but appears to include natural gasoline.

several pipe line hearings were for the most part the same as those represented at the hearings of the Foothills Pipe Lines Ltd. application, and the evidence adduced at the pipe line hearings has been considered as being pertinent to the Foothills application. An understanding that this would be done was expressed at the Foothills hearings.

In this report, the terms "natural gas liquids", "propane", "butanes", "pentanes plus", "liquefied petroleum gases" (LPG), "natural gasoline" and "condensate" appear frequently. Unless otherwise stated, they are used in the following senses:

(a) Natural gas liquids - the liquid hydrocarbons recovered from the separator treatment or the processing of natural gas, including propane, butanes and pentanes plus.

(b) Propane - a liquid hydrocarbon mixture mainly of propane containing a few per cent each of ethane and butanes.

(c) Butanes - a liquid hydrocarbon mixture mainly of butanes containing a few per cent each of propane and pentanes.

(d) Pentanes plus - a liquid hydrocarbon mixture mainly of pentanes and higher hydrocarbons containing a few per cent of butanes and lighter hydrocarbons, and includes natural gasoline and condensate.

(e) Liquefied petroleum gases (LPG) - propane or butanes or a mixture of propane and butanes.

(f) Natural gasoline - a liquid hydrocarbon mixture mainly of pentanes and higher hydrocarbons and having an ASTM (American Society for Testing Materials) Distillation End Point of 400 degrees Fahrenheit or less.

(g) Condensate - a liquid hydrocarbon mixture mainly of pentanes and higher hydrocarbons recovered or recoverable by separator treatment of certain types of natural gas.

The term "condensate" as used by the applicant and by several witnesses appearing on behalf of the applicant at the hearings shows some variance from the definition given above. Reference to condensate by the applicant in some instances includes natural gasoline, and the term "de-ethanized condensate", introduced in the October hearing in reference to a form of purchase contract, also includes propane and butanes.

THE APPLICATION OF FOOTHILLS PIPE LINES LTD.

Foothills Pipe Lines Ltd. (hereinafter called "Foothills") is a "Special Act" company incorporated by Parliament (Statutes of Canada, 1959, chapter 64). It is a wholly-owned subsidiary of Pembina Pipe Line Ltd. (hereinafter called "Pembina"). Foothills had neither the ownership of gas nor the contractual position as set out in subsection (1) of

section 5 of The Gas Resources Preservation Act, 1956, that would entitle it to apply for a permit authorizing the removal of gas, but it was authorized and empowered to make its application by Order in Council numbered O.C. 653/60 and dated May 3, 1960, issued pursuant to subsection (2) of said section 5.

In its application, Foothills asked for a permit or permits authorizing it to remove, or to cause to be removed, from the Province of Alberta the following quantities of natural gas liquids, such removal to take place over a period of twenty-five years from January 1, 1962:

Propane	not more than 11,000 barrels in any one day and not more than 4,015,000 barrels in any consecutive twelve-month period;
Butanes	not more than 14,000 barrels in any one day and not more than 5,110,000 barrels in any consecutive twelve-month period;
Condensate*	not more than 43,000 barrels in any one day and not more than 15,695,000 barrels in any consecutive twelve-month period.

It was proposed that an affiliated company, Westalta Products Pipe Line Ltd., (hereinafter called "Westalta")

* Including natural gasoline.

would gather these products from various gas processing plants in the Province through its integrated gathering system and deliver them to its main pipe line in the vicinity of Calgary. Westalta's main line would transport the products to near the International boundary in the south-eastern corner of the Province where Foothills would take delivery. Foothills would transport the mixed stream from the Province through its short section pipe line into Montana where another affiliated company, Dakota-Eastern Pipe Line Inc. (hereinafter called "Dakota-Eastern") would take delivery for transportation of the products through its pipe line to a fractionation plant in the Chicago area.

It was contemplated that these three companies would act as common carriers and would not own any of the products transported. Although Westalta's integrated gathering system was designed chiefly to gather products for the Foothills export project, witnesses for the company stated at the pipe line hearing that the system would be constructed in stages as natural gas liquids became available and that requirements within the Province would be a prime concern of the company. Furthermore, the gathering system could be used to deliver products for removal from the Province by any other pipe line or other means of transportation than that proposed by Foothills.

The main line of the Westalta system and the Foothills and Dakota-Eastern lines would be constructed only when

there was sufficient products available for transportation through them to warrant their construction.

Although three different but affiliated companies would own and operate segments of the transmission line, this line has been considered by the applicant as a single continuous unit for engineering and design purposes.

The length of each segment of transmission line would be:

Westalta main line	232 miles
Foothills	1 mile
Dakota-Eastern	1,244 miles
	1,477 miles

At ultimate throughput conditions this transmission line would be equipped with twenty pump stations and would have a capacity of 178,500 barrels per day by 1976.

The fractionation plant at the Chicago area terminal would produce specification propane and butanes and condensate acceptable to refiners and marketers in the area.

At the reopened hearing in February, 1961, details were submitted of an agreement entered into between Pembina Pipe Line Ltd., Standard Oil Company (Indiana) (hereinafter called "Standard"), Westalta Products Pipe Line Ltd., Foothills Pipe Lines Ltd. and Dakota-Eastern Pipe Line Inc., whereby Standard would assume the responsibility of purchasing gas liquid products in Alberta for transportation through the Westalta-Foothills-Dakota-Eastern system to the Chicago area

where they would be fractionated, then marketed through a distribution system to be constructed by Standard.

It was further agreed that Standard would acquire an interest in Westalta, Foothills, Dakota-Eastern and the fractionation company by the purchase of common stock of each company. When commitments for the financing of the overall transmission line and the fractionation plant are obtained, the proportion of common stock to be acquired by Standard and Pembina and that to be made available for purchase by the public and the lenders of the capital for the project would be as follows:

	Standard	Pembina	Public and Lenders
Westalta	30%	40%	30%
Foothills	35%	35%	30%
Dakota-Eastern	45%	35%	20%
Fractionation Company	45%	35%	20%

In the event that only Westalta's gathering system is constructed, Standard would have no equity in that company.

The agreement also provided that Standard would name 50 per cent of the Boards of Directors for Westalta, Foothills, Dakota-Eastern and the fractionation company. The remaining 50 per cent of the members of the Board of each company would be appointed by Pembina, one of which members must be chosen by the underwriters of the debt

financing. The number of directors to be appointed to each of the Boards of Westalta and Foothills would be eight and it was required that the one chosen by the underwriters be a Canadian citizen.

During the hearing in February, 1961, Mr. N. J. Stewart, appearing on behalf of Standard, was questioned at some length by counsel for some of the interveners as to whether or not, under the terms of this agreement, Standard would gain control of each of the companies involved in the project by reason of its power to name the chairman of its Board. Mr. Stewart expressed the opinion that Pembina and Standard would have equal voting rights and that neither company would control the project. However, the questioners did not appear to be satisfied with this opinion.*

* Some time after the hearing was closed Standard and Pembina, by letter, advised the Board that a change had been made with respect to the section of the agreement providing for the appointment of directors and enclosed a copy of the amendment endorsed by both Pembina and Standard. There is a provision in the amended section requiring all directors designated by Pembina for Westalta and Foothills to be Canadian citizens. There is also a provision for the appointment of a ninth director to the Boards of these two companies to be designated jointly by Standard and Pembina. This director, according to the agreement, must also be a Canadian citizen and be a person not employed by, or in any other way associated with any of the parties to the agreement.

Since this change was made after the hearing was closed, neither the Board nor any of the interested parties registered at the hearing have had an opportunity of questioning witnesses regarding it.

As mentioned previously, Standard would purchase products in Alberta for transportation through the pipe line system to the marketing area. It was provided in the Pembina-Standard agreement that Standard would purchase through a subsidiary purchasing company and that the purchasing company would endeavour to enter into conditional long term purchase contracts with producers of natural gas liquids, which contract would have a basic term of twenty years. There was also a provision for the purchasing company terminating its contract with sellers, if by January 1, 1965, a sufficient volume of products has not been secured by contract to make the project economical.

Pursuant to the agreement, Standard named its wholly owned subsidiary, Tuloma Gas Products Company, (hereinafter called "Tuloma") as the purchasing company and a form of purchasing contract under which Tuloma would endeavour to acquire the long term commitments of natural gas liquid products was submitted at the February, 1961, hearing.

Mr. G. H. Steer, Q.C., assisted by Mr. K. L. Perry, represented both Foothills and Westalta at all hearings relative to the applications of these two companies.

INTERVENERS

It has been noted above that in addition to the evidence presented to the Board at the hearing of the Foothills application, some evidence presented at hearings concerning applications under The Pipe Line Act, 1958, is

applicable to the Foothills application. Some companies represented as interveners at the Foothills hearings were the applicants at one or another of the pipe line hearings, and each at its own hearing presented its position at length. Other interveners made their representations at one or more of the hearings as they saw fit, several appearing only at the reopened Foothills hearing when the terms of the proposed Tuloma contract under which the producers could dispose of their products were known.

Britamoil Pipe Line Company Limited (hereinafter called "Britamoil") is a subsidiary of The British American Oil Company Limited (hereinafter called "British American") and both were represented at all of the hearings by Mr. R. L. Fenerty, Q.C. and Mr. W. M. Winterton. Britamoil's application asks for permits to construct pipe lines to transport the liquid products from gas processing plants operated by British American to British American refineries in the Province and other markets. Additional use of some existing Britamoil oil pipe lines to carry the liquid products is contemplated.

Provincial Products Pipelines Limited (hereinafter called "Provincial Products") was represented by Mr. A. S. Williamson, Q.C., at all of the hearings except those of the Hudson's Bay and Royalite applications and the Foothills reopened hearing. It is an applicant for pipe line permits and

proposes to serve the market within Alberta and to deliver the excess products to Edmonton for transhipment by Interprovincial Pipe Line to eastern markets and by Trans Mountain Oil Pipe Line to west coast markets. Since the Provincial Products hearing, there has been a change in the ownership of this company, and the new owners have indicated that they would not wish to develop a project in the manner proposed at the hearing.

Hydrocarbons Pipeline Limited (hereinafter called "Hydrocarbons") is a subsidiary of Canadian Hydrocarbons Limited (hereinafter called "Canadian Hydrocarbons") and both were represented at most of the hearings by Mr. R. A. MacKimmie, Q.C. Canadian Hydrocarbons also has a 40 per cent interest in Alberta Underground Storage Limited (hereinafter referred to as "Alberta Underground") which was represented by Mr. F. T. Phillips. This group contends that facilities for the transportation of liquefied petroleum gases (LPG's) should be added to only as required after use of existing facilities, and that the Foothills-Westalta plan would disrupt the marketing of LPG's in western Canada and would not adequately serve local markets.

Hudson's Bay Oil and Gas Company Limited (hereinafter called "Hudson's Bay"), being the applicant at one of the pipe line hearings, is seeking a permit to construct lines to transport the condensates from gas processing plants in the Pincher

Creek-Waterton area to Carway on the Alberta-Montana border for sale to Continental Oil Company. At the Westalta hearing, Hudson's Bay submitted evidence to cast doubt upon the availability to the Foothills-Westalta project of products from the proposed Windfall plant. This company was represented at some hearings by Mr. J. H. Currie and at some by Mr. R. A. MacKimmie, Q.C.

Royalite Oil Company, Limited (hereinafter called "Royalite") in the application of its Valley Pipe Line Department, asks permission to construct pipe lines to be used in the transportation of natural gasolines and stabilized gas condensate from the Wildcat Hills and Jumping Pound plants to Calgary. Its application was presented by Mr. E. J. Chambers, Q.C.

Alberta Gas Products System Ltd. (hereinafter called "Alberta Gas Products") was represented at the Royalite hearing by Mr. C. M. Leitch, but made no representations.

Canadian Chemical Company, Limited (hereinafter called "Canadian Chemical") was represented at the Foothills hearings and all of the pipe line hearings, except those held upon the applications of Britamoil, Hudson's Bay and Royalite, by Mr. W. R. Sinclair. It is engaged in the petrochemical industry and has a plant at Edmonton. The continued supply of LPG's as raw materials at a price that will permit it

to manufacture its products for a competitive market is essential for this intervener, and a project that would bring the LPG's produced in Alberta to a focal point that was not near Edmonton is opposed by the intervener.

Canadian Industries Limited (hereinafter called "C.I.L.") was represented at the Foothills hearings and at a majority of the pipe line hearings. Its position and the basis of its objection are practically the same as those of Canadian Chemical Company, Limited.

Trans-Canada Pipe Lines Limited (hereinafter called "Trans-Canada") was represented at all the hearings but that of the Royalite application and participated to the extent of cross-examining witnesses at some. It may perhaps be inferred that this intervener does not wish to be excluded from consideration as a possible carrier of liquid products to extraprovincial markets.

Interprovincial Pipe Line Company (hereinafter called "Interprovincial") was represented at the Westalta, Foothills and Hudson's Bay hearings by Mr. R. B. Burgess. It operates an oil pipe line from Edmonton to Sarnia and Port Credit in Ontario with a subsidiary passing en route through North Dakota, Minnesota, Wisconsin and Michigan. Interprovincial believes in the use of such an existing oil pipe line where available, for the transportation of liquid gas products, and contends that such use may be a key factor in getting the products to distant markets at competitive prices.

At the reopened hearing Interprovincial stated that it had recently shipped a large batch of natural gasoline to Michigan commingled with crude oil and that studies had shown that the company could economically extend its present system to the Chicago area for the transportation of natural gas liquids. A schedule of tariffs for these products was also announced.

The Liquefied Petroleum Gas Association entered appearances at some of the pipe line hearings. This organization has 65 member firms participating in the production, distribution, marketing and manufacturing of LPG's in western Canada. The Association submitted that the present and foreseeable requirements of domestic and industrial consumers for LPG's in western Canada including Alberta should be given adequate consideration before the removal of LPG's by pipe line is permitted and that the competitive position of LPG's with respect to other fuels in western Canada including Alberta should not be prejudiced.

Goliad Oil & Gas Company intervened at the Westalta hearing to oppose the gathering phase of the Westalta-Foothills project. Goliad operates the Pembina central fractionation plant which manufactures liquid by-products of natural gas processing. Not only is a long-range pipe line gathering system, as proposed by Westalta, premature, Goliad submitted, but it is objectionable because the light

hydrocarbons extracted by processing should not be mixed with condensate, since the markets for the different products are generally not the same. Goliad further contended that the Westalta pipe line system would have the effect of restricting the local markets to those that could be served by the terminals of the system and thus lead to higher consumer costs, and that Goliad does not desire that either its local or export markets be restricted or limited by the proposed pipe line system.

Triad Oil Co. Ltd. registered as an interested party at the Westalta hearing but did not otherwise participate in any of the proceedings.

Canadian Husky Oil Ltd. appeared at the reopened hearing. As a producer it objected to the Tuloma contract for six reasons. As a refiner it objected that the Westalta-Foothills-Dakota-Eastern system would not serve the refineries of itself and an affiliated company at Moose Jaw, Fort William and Cody, Wyoming.

Canadian Superior Oil of California, Ltd. also objected to the Tuloma contract at the reopened hearing. It would be extremely reluctant to enter into such a contract for four specified reasons.

Shell Oil Company of Canada, Limited, at the reopened hearing, also voiced objection to the Tuloma contract.

Three bases for objection were given. Shell's witness stated also that as an integrated company it would not wish to sell refinery raw material to a competitor on the basis of a twenty-five year contract.

Witnesses representing four producing companies, Calgary and Edmonton Corporation, Fargo Oils Limited, Medallion Petroleums Limited and Jefferson Lake Petrochemicals of Canada Ltd. appeared at the reopened hearing upon being called by counsel for Hudson's Bay. All objected to the length of the term of the Tuloma contract and some had other objections to the contract. The Calgary and Edmonton and the Jefferson Lake witnesses stated that their companies would not sign the contract. The witnesses from Fargo and Medallion stated their companies would not voluntarily sign such a contract, but as holders of minor interests in gas fields or plants were in such a position that they might be forced to enter into a sales contract if it should be accepted by the producers with larger interests in the fields or plants.

THE BASIS OF CONSIDERATION

The application by Foothills is the first application to the Board for a permit under The Gas Resources Preservation Act, 1956, authorizing the removal from the Province of any liquid substances. The definitions of "gas" and "oil" in the Act are such that propane and

butanes recovered from natural gas fall within the former definition. Consequently their removal from the Province without the authority of a subsisting permit under the Act is prohibited except only in a case where the application of the Act has been excluded under the provisions of section 24.

The object of The Gas Resources Preservation Act, 1956, as expressed in section 3 is to effect the preservation and conservation of the oil and gas resources of the Province and to provide for their effective utilization having regard to the present and future needs of persons within the Province. Section 8 states that a permit for the removal of gas shall not be granted unless the Board is of the opinion it is in the public interest to do so having regard to the present and future needs of persons within the Province and the established reserves and the trends in growth and discovery of reserves of gas in the Province. These statutory provisions apply in the case of an application for a permit for the removal of propane and butanes from the Province, just as they do if the product to be removed is ordinary gas (mainly methane). The Board may not issue a permit unless in its opinion the removal of the propane and butanes would not prejudice the fulfilment of the present and future requirements of persons within the Province.

Accordingly, the Board has inquired into and has

assessed the present and future production of propane and butanes and also the present and future requirements of Alberta for these products. The problem differs from that relating to ordinary gas because natural gas liquids are produced incidentally to ordinary gas and not, as in the case of ordinary gas, in response to a market demand for them. A complication arises from the fact that the amount of propane and butanes recovered from ordinary gas may be varied within certain limits and the recovery within these limits is dependent upon the market demand for the products. Thus from the presently established gas reserves, most of which are committed either to Alberta or extraprovincial markets, it is possible to calculate the limits of production of propane and butanes over the life of the fields of their origin. This is unavoidable production and it must be used or reinjected into the ground for future use; the Board will not permit it to be flared or otherwise wasted. The procedure of reinjection and subsequent reproduction and reprocessing is costly in itself and the resulting deferment of income is unattractive. A serious loss of products can also occur in the reservoir. Immediate use without the need for long term storage is most desirable. To the extent that the products can be used in Alberta, they should be; to the extent that surpluses exist over and above Alberta's requirements, sales to export markets are desirable. In calculating the surpluses,

however, the future requirements of Alberta must be considered, for export by a specially built pipe line would involve a twenty to twenty-five year commitment.

The Board takes the position that Alberta's future requirements for a period of thirty years should be considered. This is the same period considered by the Board in the case of an application for permit for ordinary gas. These future requirements may be compared with the estimated future production of the products. Future production of natural gas liquids will come from

(a) established reserves of gas presently producing or scheduled to produce,

(b) established reserves of gas not presently being produced or scheduled to be produced, and

(c) gas reserves yet to be discovered.

In comparing the requirements against the production, the Board believes it proper to give full weight to the estimated production of categories (a) and (b), but with respect to category (c) to give full weight only to the production anticipated from the reserves expected to be discovered over the next two-year period, and to determine the trend in the volumes surplus to Alberta's requirements having regard to the production anticipated over a ten-year period. Again, this is the procedure, slightly modified, that is used by the Board in the comparison of requirements and supply of ordinary gas.

The Gas Resources Preservation Act, 1956, exempts natural gasoline from the provisions of the Act and does not apply to condensate. In so far as the application of Foothills is concerned, only propane and butanes need be covered by permit. On the other hand the Board has found it desirable in considering the application to recognize the fact that the scheme does contemplate the export of propane, butanes and condensate, and in fact that condensate constitutes some 65 per cent of the proposed export stream. Clearly the design of the pipe line facilities, their cost, the economic feasibility of the proposal and its financibility are dominated by the condensate rather than the propane and butanes.

The broad reference in section 3 of The Gas Resources Preservation Act, 1956, to oil and gas resources has more than ordinary significance in considering the current application as the use of condensate is nearer to that of oil than of gas and the properties of the products that concern the pipe line operator are also nearer to those of oil. The marketing of Alberta condensate in most markets available to it cannot help but affect the marketing of Alberta crude oil, and in any market where Alberta crude oil meets resistance, large shipments of condensate are likely to develop a similar resistance.

The Foothills application is closely related to the application under The Pipe Line Act, 1958, of Westalta Products Pipe Line Ltd. and also can hardly be considered separate from the proposal of Dakota-Eastern Pipe Line Inc. For these reasons the Board has not hesitated to consider the proposals of all three companies together when it seemed proper to do so.

F I N D I N G S

The Board having publicly heard the application under The Gas Resources Preservation Act, 1956, of Foothills Pipe Lines Ltd., having studied the evidence submitted at the public hearings, and having regard to the advice of its staff, to its own knowledge, and to its responsibilities under the Act, finds as follows:

I IN THE MATTER OF THE FUTURE PRODUCTION OF NATURAL GAS LIQUIDS IN ALBERTA

The Board forecasts that the production of natural gas liquids from presently established gas reserves plus reserves expected to be discovered in the next two years will increase from 30,000 barrels per day in 1961 to 90,900 barrels per day in 1965 under existing recovery incentives. With increased incentives for the recovery of propane and butanes, production of natural gas liquids is estimated to reach 102,400 barrels per day in 1965.

For propane, the rate of production is expected to increase from the present level of 5,400 barrels per day to 11,900 barrels per day by 1965 under existing recovery incentives and to 17,400 barrels per day with increased incentives.

In the case of butanes it is estimated that under existing recovery incentives the rate of production will increase from the present level of some 4,600 barrels per day to 10,200 barrels per day in 1965. Under conditions

of increased recovery incentives the 1965 production is estimated at 16,200 barrels per day.

Production of pentanes plus is expected to increase from the present rate of some 20,000 barrels per day to about 68,800 barrels per day in 1965. The recovery of pentanes plus is not dependent on marketing conditions.

In the case of all natural gas liquids the rate of production beyond 1965 will be considerably influenced by discoveries of gas beyond 1963. The Board believes that production will continue to grow for a fifteen- to twenty-year period, at least in pace with Alberta's requirements.

Details of the estimates and opinions submitted by the applicant and the interveners and of the Board's own analysis appear in Appendix A.

II IN THE MATTER OF PRESENT AND FUTURE REQUIREMENTS OF ALBERTA FOR NATURAL GAS LIQUIDS

The Board estimates the average requirements of propane in barrels per day will grow from the 1961 level of some 5,000 to 11,800 in 1970, 17,800 in 1980 and some 23,300 in 1990.

For butanes the Board estimates the average requirements in barrels per day will grow from the 1961 level of some 3,000 to 5,200 in 1970, 8,000 in 1980 and some 11,300 in 1990.

The Board estimates that the pentanes plus requirements, now some 7,100 barrels per day, will increase to 30,000 barrels per day in 1970, 42,000 barrels per day in 1980 and to the order of 60,000 barrels per day in 1990.

Details of the estimates of the applicant and the interveners and of the Board's own analysis appear in Appendix B.

III IN THE MATTER OF THE PRESENT AND FUTURE REQUIREMENTS OF AREAS IN CANADA ADJACENT TO ALBERTA FOR PROPANE

Alberta has been the source of supply of propane for south-eastern British Columbia and western Saskatchewan. The Board believes this is a logical arrangement and that the requirements of these areas should be considered along with those of Alberta. The Board estimates the average requirements for propane in barrels per day will increase from the 1961 level of some 500 to 700 in 1970, 1,300 in 1980 and 1,600 in 1990. Details of these estimates are given in Appendix C.

IV IN THE MATTER OF MEETING THE PRESENT AND FUTURE REQUIREMENTS OF ALBERTA AND ADJACENT AREAS IN CANADA FOR NATURAL GAS LIQUIDS AND THE RESULTING SURPLUS OF NATURAL GAS LIQUIDS

The Board has considered the seasonal variation in the market demand for natural gas liquids in Alberta. The seasonal variation is substantial only in the case of propane and may readily be accommodated from the anticipated production with the aid of available storage facilities.

The Board has considered the range of composition of the pentanes plus which will be produced in Alberta and has compared this with the quality requirements which the Board

anticipates Alberta refiners will impose. More than adequate volumes of pentanes plus of the proper composition and quality will be available.

A year by year comparison of the forecast production of natural gas liquids and the forecast Alberta requirements for them shows that surpluses of natural gas liquids plus now exist and will grow rapidly, totalling 54,500 to 68,000 barrels per day in 1965, depending on recovery incentives for propane and butanes. These surpluses are after provision for the propane requirements of south-eastern British Columbia and western Saskatchewan.

In the case of propane, the 1961 production and requirements will be approximately in balance. A surplus of 2,500 to 9,000 barrels per day, however, depending on the recovery incentives, will exist by 1965. For butanes, there will be a surplus of about 1,600 barrels per day in 1961 and this is expected to increase to 7,000 to 14,000 barrels per day, depending on the recovery incentives, by 1965. The 1961 surplus of pentanes plus, estimated at 10,000 barrels per day, is expected to grow to 45,000 barrels per day in 1965.

From 1965 on the level of surpluses in all cases will depend upon the new gas discoveries beyond 1963. The Board studies show that new gas discoveries will yield natural gas liquids in volumes which will maintain the surplus at about the 1965 level for a further period of fifteen to twenty years.

Details of the estimates presented by the applicant and the interveners and of the Board's analysis appear in Appendix D.

V IN THE MATTER OF THE MAXIMUM QUANTITY OF SURPLUS NATURAL GAS LIQUIDS WHICH MIGHT BECOME AVAILABLE TO FOOTHILLS

Certain movements of propane into Idaho and Washington have taken place in the past and it seems only reasonable to assume that at least some of these will continue. Similarly, butanes have been shipped to various markets in the Pacific North-west. The Board estimates that a minimum of 1,600 barrels per day of propane and 1,000 barrels per day of butanes will move to such extraprovincial markets in 1965. This leaves for 1965 a maximum surplus available to Tuloma and thence to Foothills of 900 to 7,400 barrels per day of propane (depending on market incentive) and of 6,000 to 13,000 barrels per day of butanes (depending on market incentive).

Of the some 45,000 barrels per day of pentanes plus which the Board estimates will be surplus to Alberta's requirements in 1965 some at least could not be contracted for by Tuloma. The existing facilities of Interprovincial and Trans Mountain will undoubtedly transport some quantities of pentanes plus to markets in the Pacific North-west and eastern Canada. The Board estimates that the minimum of such volumes will be some 8,000 barrels per day in 1965. Further, Hudson's Bay proposes the movement of condensate to Cut Bank, Montana, and beyond. The Board believes this volume would grow from some 8,500 barrels per day in 1962 to over 13,000 barrels per day by 1970. While the Hudson's Bay pipe line application has not yet been approved, the Board's recommendation is that

it should be. The maximum quantity of pentanes plus which Tuloma might contract for in 1965 is estimated by the Board at 25,000 barrels per day.

Totalling, the maximum quantity of surplus natural gas liquids which might become available to Tuloma for transport and removal from the Province by Foothills is in the order of 30,000 to 45,000 barrels per day depending on the recovery incentive for propane and butanes. The Board does not expect that there will be significant increases in the quantities of surplus natural gas liquids beyond 1965.

Details of the Board's calculations of the maximum quantities of natural gas liquids which might become available to Foothills appear in Appendix E.

VI IN THE MATTER OF THE APPLICANT'S OWNERSHIP OF OR CONTRACTS FOR THE PURCHASE OR TRANSPORTATION OF PROPANE OR BUTANES PRODUCED IN ALBERTA

Foothills is not the owner of any of the natural gas liquids it proposes to remove from the Province, nor does it have contracts or other arrangements with owners of product to purchase or transport them. A contract has been entered into by Pembina, Westalta, Foothills, Dakota-Eastern and Standard, a result of which would be that if Tuloma succeeds in contracting for sufficient natural gas liquids to justify the project, Westalta, Foothills and Dakota-Eastern would transport the liquids. The minimum volume of liquids required by Tuloma to actuate the contract was stated to be 50,000

barrels per day with good prospects for growth.

No owners of natural gas liquids have signed or indicated agreement with the Tuloma contract and several testified that they were opposed to it.

Further details of the contractual situation are given in the Introduction and in Appendix F.

VII IN THE MATTER OF THE PROPOSED TARIFFS, THE ECONOMIC FEASIBILITY AND THE FINANCIBILITY OF THE WESTALTA MAIN LINE AND THE FOOTHILLS-DAKOTA-EASTERN SYSTEM

The Board concurs with the applicant and its associates that a volume of some 50,000 barrels per day of natural gas liquids - with good prospects for growth - is necessary to permit reasonable tariffs and to make the Westalta main line - Foothills-Dakota-Eastern system economically feasible and financible. At the lesser volume of approximately 30,000 to 45,000 barrels per day, which the Board considers to be a maximum available volume, the Board does not believe that reasonable tariffs could be set or that the project would be economically feasible or financible.

Details of the relevant evidence and the Board's views appear in Appendix F.

VIII IN THE MATTER OF ALTERNATE MEANS FOR THE EXPORT OF NATURAL GAS LIQUIDS, THE EFFECTIVE UTILIZATION OF THE OIL AND GAS RESOURCES OF THE PROVINCE AND THE PUBLIC INTEREST

The Board recognizes the marketing difficulties which will shortly be encountered in connection with the developing

surpluses of natural gas liquids and the desirability of establishing markets for these products in areas not now supplied from Alberta. The Board does not believe, however, that it would be best from the overall viewpoint of the marketing of Alberta crude oil and natural gas liquids or in the public interest to attempt the entry at this time of large volumes of natural gas liquids into the Chicago marketing area; rather it believes that efforts should be made to market the natural gas liquids over a wide area and to develop new markets gradually. It believes that the existing pipe line facilities (expanded as necessary) of Trans Mountain and Interprovincial and the proposed pipe line of Hudson's Bay would permit this type of development for pentanes plus and to a lesser extent for butanes. Surplus propane and part of the surplus butanes may be moved to some extent by rail and truck, but these methods will not likely provide for the economic marketing of all the products. Other means may have to be developed for the marketing of these surpluses or it may become necessary to reinject them into underground reservoirs in the interest of conservation. Details of the Board's views on these matters are presented in Appendix G.

IX IN THE MATTER OF THE DISPOSITION OF THE APPLICATION OF FOOTHILLS

Having regard to the maximum volume of surplus natural gas liquids anticipated by the Board to be available

by 1965, the significance of these volumes with respect to tariffs, economic feasibility and financibility, the applicant's contractual situation, the views of owners of natural gas liquids, alternate means for the removal of natural gas liquids from Alberta, and the public interest as assessed by the Board, the Board, with the approval of the Lieutenant Governor in Council, denies the application.

Respectfully submitted,

G. W. Govier, P.Eng.,
Deputy Chairman.

A. F. Manyluk, P.Eng.,
Board Member.

V. Millard,
Acting Board Member.

Dated at Calgary, Alberta,
this 21st day of June, 1961.

APPENDIX A

THE PRESENT AND FUTURE PRODUCTION AND THE RESERVES OF NATURAL GAS LIQUIDS IN ALBERTA

Future Production of Natural Gas Liquids

As mentioned in the body of this report, the Board has decided that full effective protection for Alberta's requirements of natural gas liquids for a future thirty-year period is necessary. For this reason, the Board has concerned itself with a thirty-year forecast of natural gas liquid production from established reserves, even though recognizing the difficulties associated with such long term forecasts.

The Board agrees with the view put forward by each of the applicants at the hearings that a considerable amount of natural gas liquid production from gas reserves not yet discovered will take place during the thirty-year period. In order that some weight may be given to these liquids in considering provision for the overall future provincial requirements, the Board has also given consideration to natural gas liquid production from gas reserves not yet discovered. Due to the many uncertainties involved in the preparation of such a forecast, it has been concluded by the Board that little confidence could be placed in a prediction of liquids to be produced from the total reserves to be discovered over the next thirty years. As a result, the forecast of natural gas liquid production from reserves not yet discovered, as pre-

pared by the Board and included in this Appendix, deals only with the reserves expected to be discovered during the ten-year period 1961 to 1970 inclusive. The Board believes that a reasonable estimate may be made on this basis. The forecast includes an estimate of the manner in which this ten years of "trend gas" and the resulting natural gas liquids will be produced over the next thirty years.

Production of Natural Gas Liquids from Established Gas Reserves

During the hearings of the Westalta application and the Foothills application, evidence as to the forecast of natural gas liquid production from established reserves was presented, on behalf of the applicants, by Dr. J. C. Sproule, Mr. G. A. Van Wielingen and Mr. J. B. Maughan of the consulting firm of J. C. Sproule & Associates.

In their submission, natural gas liquid production from established reserves is estimated to increase from the present rate of some 30,000 barrels per day to a peak of over 68,000 barrels per day by 1963, and to decline thereafter to some 29,000 barrels per day by 1981, the last year of their forecast. In terms of individual products, an increase in the propane production from the present rate of about 5,500 barrels per day to a peak of some 12,500 barrels per day by 1963, with a decline in production to some 7,800 barrels per day by 1981 is estimated. Similarily, the butanes production is predicted to increase from the present rate of some 4,500 barrels per

day to a peak of about 12,700 barrels per day in 1963, and to decline thereafter to some 7,500 barrels per day by 1981. The pentanes plus production is forecasted by J. C. Sproule & Associates to increase from the present rate of about 20,000 barrels per day to some 43,000 barrels per day by 1963 and to decline to about 14,000 barrels per day by 1981.

In virtually all cases these production figures reflect the very maximum recovery of these products, and in fact Mr. Van Wielingen indicated that the forecast could be considered as much an availability forecast as an actual production forecast.

In brief, the forecast as submitted by Sproule was prepared in the following manner:

1. The gas production was based on deliverability schedules previously prepared by the Board or gas export companies.
2. The composition of the produced gas was based on available analyses.
3. The retrograde effects were estimated.
4. The plant recoveries were based on plant history or on actual plans for future plants where available. In other cases they were estimated at approximately 50 per cent for propane, 75 per cent for butanes and 100 per cent for pentanes plus. (In the case of propane and butanes the recoveries represent maximum values practically attainable).

The Stanford Research Institute, on behalf of Britamoil, presented a detailed forecast of the natural gas liquid production from presently established reserves for the period 1960 to 1970. The forecast was presented as evidence by Mr. S. H. Clark of the Stanford Research Institute. He was supported throughout examination by Messrs. J. A. Strand, S. J. Anderson and R. E. Martin of The British American Oil Company Limited, who collaborated in the preparation of the forecast.

In the Stanford forecast it is estimated that natural gas liquid production from established reserves will increase from the present rate of some 30,000 barrels per day to a peak of about 75,000 barrels per day by 1964, and then decline to some 59,000 barrels per day by 1970. It is predicted that propane production will increase from the present rate of about 5,500 barrels per day to a rate of some 9,100 barrels per day by 1964, and then decline to about 7,900 barrels per day by 1970. The forecast shows the present butanes production of about 4,500 barrels per day to increase to over 10,000 barrels per day by 1964 and to decline to some 8,400 barrels per day by 1970. The pentanes plus production is forecasted to increase from the present rate of about 20,000 barrels per day to a rate in excess of 55,000 barrels per day by 1964, and to decline to about 42,000 barrels per day by 1970.

The forecast submitted on behalf of Britamoil was prepared generally in the following manner:

1. The gas production was based on deliverability

schedules previously prepared by the Board or gas export companies.

2. The composition of the produced gas was based on available analyses.
3. The retrograde effects were estimated.
4. The plant recovery factors were based on production history or on future plant design plans where possible. In cases where this was not possible the factors were estimated, having regard for the probable size of the plant, the likely location, and the pipe line specifications for the residue gas. Propane and butanes recovery was not anticipated from all processing plants.

During the hearing of Provincial Products' application Mr. F. D. Valentino of Fish Northwest Constructors submitted on behalf of Provincial Products, a natural gas liquid forecast for the years 1960 to 1971 inclusive. This forecast concerns itself only with those plants that are currently producing or where plant design plans are definite.

The forecast indicates that the liquid production from this portion of established reserves will increase from the present rate of about 30,000 barrels per day to a peak of some 76,000 barrels per day in 1963, and then decline to about 65,000 barrels per day by 1971. The propane production is indicated to increase from the present rate of some 5,500

barrels per day to a peak of about 10,500 barrels per day in 1963, and to decline very slowly to about 10,100 barrels per day by 1971. The butanes production is forecasted to increase from the present rate of some 4,500 barrels per day to about 10,900 barrels per day in 1963, and to decline very slowly to 10,700 barrels per day by 1971. The pentanes plus production is forecasted by Fish Northwest to increase from the present rate of some 20,000 barrels per day to a peak of over 54,000 barrels per day in 1963, and to decline to less than 45,000 barrels per day by 1971.

Mr. Valentino stated that the predicted producing rates for various fields, as set out in his forecast, were based on estimates given to him by producers in each of the fields involved.

Mr. O. K. Wetzel of the firm of Purvin & Gertz Inc., presented, on behalf of Hydrocarbons, a forecast of liquid production from established reserves based on the previously discussed forecast submitted to the Board by Stanford Research Institute. Mr. Wetzel stated that the forecast submitted on behalf of Britamoil was checked by his firm in detail and for purposes of his submission was adopted as the most accurate forecast available at that time.

During the hearing of the Hudson's Bay application, Mr. B. R. Leeds of Hudson's Bay Oil and Gas Company Limited presented a liquid production forecast for certain pools in the south-western part of the Province. Since the forecast he

submitted concerned itself with production from a relatively small portion of the Province, it's usefulness to the Board has been limited to assisting in predicting production from only three fields included in the study.

The Board has prepared its own thirty-year forecast of natural gas liquid production from established reserves. Throughout the preparation of this forecast the Board has relied heavily on the extensive evidence submitted by the applicants or interested parties at the hearings, and has attempted to give proper consideration to each detail of the evidence. In addition to this the Board has called upon its own knowledge and the knowledge of its staff.

Tables A-1, A-2 and A-3 present the Board's thirty-year forecast of propane, butanes and pentanes plus production from established gas reserves. The tables reflect the production of gas to meet future provincial gas requirements (in part), and existing commitments for extraprovincial markets. In addition to this the tables reflect gas production from certain fields (established reserves) that will likely provide for additional removal from the Province to be approved in the future. It must be pointed out that these tables do not reflect the entire liquid production from the gas reserves that have been discovered during the year 1960. Since allocation of these reserves to either the provincial market or the extraprovincial market has not been made, and since knowledge as to the recoverable liquid content of these reserves

is very limited, the major portion of the 1960 gas discoveries has been included as part of the trend studies. In fact, Tables A-1, A-2 and A-3 include liquid production from only 1.1 trillion cubic feet of the 4.76 trillion cubic feet of gas developed during the period October 1, 1959, to December 31, 1960.

The following is a brief summary of the manner in which the forecast was prepared:

1. The gas producing rates for each field or area have been taken from the latest deliverability schedules available to the Board. Where schedules are not available or are outdated, gas production has been estimated at the rate of one million cubic feet per day for each ten billion cubic feet of available reserves. In areas where the plant feed will be oilfield separator gas, the producing rate has been forecasted on the basis of the expected oil allowables and gas-oil ratio behaviour for the pools involved. Where fields are not yet producing gas, the date of initial production has been estimated, having regard for the Board's knowledge of plans for pipe line construction in the Province.
2. The composition of the gas produced from each pool has been based on the most suitable analysis available to the Board.

3. Changes in the composition of the gas being produced from any particular pool have been based on reservoir fluid studies wherever possible. In areas where retrograde effects are anticipated but fluid studies are not available, changes in liquid content have been estimated by comparison to available studies of similar reservoirs. Where gas cycling schemes to curtail retrograde losses are expected, the production forecast reflects the Board's estimate of how liquid recovery will be affected by cycling. In general, gas cycling schemes have been visualized to be of about fifteen years in duration, with breakthrough occurring in the fourth or fifth year.

4. Plant recovery efficiencies have been based on plant history wherever fields have been producing for a reasonable length of time. In many areas plants are in the planning or construction stage or have been operating for only a short time. In these instances recoveries have been based on submissions presented to the Board in support of applications under section 38 of The Oil and Gas Conservation Act or on the Board's general knowledge of plans for future plants in the Province. In areas where the Board has no information regarding the plant design, the recovery efficiencies have been

> estimated assuming current marketing conditions and having regard for the quantity and composition of the gas to be processed and for the residue gas pipe line calorific and dew point standards.

In the case of propane and butanes, the Board recognizes that plant recovery efficiencies depend almost entirely upon the economics of liquid recovery. Since these economics are dictated largely by the market situation for these products, it is logical that as marketing conditions change actual plant recoveries may also change. Acknowledging the fact that there is little economic incentive to recover propane and butanes from plants being constructed today, the Board has included as part of Tables A-1 and A-2 a supplementary forecast reflecting additional incentive to recover these products. This additional incentive could very well be the result of the construction of a pipe line such as the one proposed by Foothills to carry liquid products to some substantial market not presently being served by this Province. The particular fields where propane and butanes production would not be expected under current marketing conditions but where the Board predicts that propane and butanes production would occur under favourable conditions are Calgary, Carstairs, Crossfield, Gilby, Minnehik-Buck Lake, Waterton and Windfall. For the purposes of this study it has been estimated that production from these seven fields would begin in 1964, and that recovery efficiencies would range from 30 to 40 per cent

for propane and from 55 to 65 per cent for butanes. In addition to liquid production from these fields, the Board has included, as part of the supplementary forecast, an estimated increase in production that may result from higher recoveries at plants already producing propane and butanes. These increased recoveries would be made possible by changes in plant design brought about by the additional economic incentive to produce these products.

Since virtually complete removal of pentanes plus from wet gas streams is necessary in order to meet dew point specifications of residue gas pipe lines, it is not expected that additional economic incentive would significantly affect the pentanes plus production forecast.

Tables A-1 and A-2 also include estimates of the additional propane and butanes production from established reserves that may result in the future as a by-product of the reprocessing of pipe line gas within the Province. This reprocessing would likely take place to provide raw materials, especially ethane, for the expansion of the petrochemical industry in Alberta. The propane production from the Canadian Industries Limited plant at Edmonton is an example of this type of by-product production, and is in fact included in this portion of the forecast.

The Board's forecast of propane production from established gas reserves as presented in Table A-1 shows an increase from the present rate of about 5,400 barrels per day to a

peak of some 10,000 barrels per day in 1965 provided that no additional incentive to recover propane exists. The production would then decline to about 5,000 barrels per day by 1990. The expected increase over the next five years is the result of new plants being placed on production, and of additional quantities of gas being processed at existing plants. The decline thereafter is the result of retrograde effects in certain pools, as well as a general decline in gas producing rates. The table also shows that, under conditions of increased economic incentive and with some reprocessing of pipe line gas, provincial propane production will peak at some 14,700 barrels per day in 1965 and then decline to about 7,500 barrels per day by 1990.

Table A-2 indicates the forecast butanes production from established gas reserves to increase from the present rate of about 4,600 barrels per day to a peak of some 8,500 barrels per day in 1965, and to decline to some 3,700 barrels per day by 1990, with no increase in incentive to recover butanes. The reasons for the rapid increase in the initial years and the steady decline thereafter are essentially the same as in the case of propane. The table also indicates that with increased economic incentive and additional production from pipe line gas reprocessing, the butanes production would peak in 1965 at about 13,500 barrels per day, and would decline to some 5,700 barrels per day by 1990.

Table A-3 shows the pentanes plus production from established gas reserves to increase from the present rate of

about 20,000 barrels per day to some 58,000 barrels per day by 1965, and to decline to some 13,000 barrels per day by 1990. The anticipated increase over the next few years is due to new plants being placed on stream and to increased production at existing plants. The decline from 1965 onward is mainly the result of retrograde effects, which for pentanes plus are very substantial, but is also due in part to a general decline in gas producing rates. As previously mentioned, the Board does not believe that future changes in the marketing situation will significantly affect the production of the pentanes plus.

Table A-4 is a summary of the Board's thirty-year natural gas liquid production forecast from established reserves. Column 1 of the table sets out the years 1961 to 1990 inclusive. Columns 2, 3 and 4 show the anticipated propane, butanes and pentanes plus production assuming that there will be no additional economic incentive to recover these products. Columns 5, 6 and 7 present the forecast propane, butanes and pentanes plus production, assuming no additional economic incentive but additional reprocessing of pipe line gas. The liquid production as set out in columns 8, 9 and 10 of the table reflects a situation of additional incentive to recover liquids and the reprocessing of pipe line gas.

Table A-5 has been prepared to compare the Board's forecast of natural gas liquid production from established gas

reserves to those forecasts presented at the recent hearings and discussed earlier in this appendix. Included in the table are the Board's production estimates for propane, butanes and pentanes plus for the years 1962, 1965, 1970 and 1980 for each of the economic situations illustrated in Table A-4. Also included are comparable estimates as submitted on behalf of Foothills and Westalta, Britamoil and endorsed by Hydrocarbons, and Provincial Products.

In comparing the total liquid production as forecasted by the Board to the total as forecasted by J. C. Sproule & Associates on behalf of Foothills and Westalta, it must be remembered that the Sproule estimates do not include production from Harmattan East, Harmattan-Elkton, Lookout Butte, Swan Hills and many other small fields that are included in the Board studies. A comparison with this in mind shows that the propane and butanes production for the same fields is forecasted to be considerably greater by Sproule than by the Board - even under maximum recovery conditions. The main reason for this difference is that very high recovery factors for propane and butanes at many of the plants presently in the planning or construction stage are assumed in the Sproule study, where according to plans available to the Board actual recoveries of these products will be low or non-existent. The pentanes plus as forecasted by Sproule compares very closely with the Board forecast for production from the same fields or areas. Since the Board forecast covers all

reserves in the Province, the total predicted production is greater than that forecasted by Sproule.

A comparison between the Board studies and the forecast submitted by Stanford Research Institute on behalf of Britamoil can only be made bearing in mind that the Britamoil forecast does not include production from Swan Hills and many other small fields in the Province which have been included in the Board's study. Such a comparison reveals that the propane and butanes production as estimated for Britamoil lies somewhere between the minimum and maximum production as forecasted by the Board. The reason for this is that the Britamoil study has assumed propane and butanes production as a normal course from four of the seven fields where the Board now expects that additional incentive will be necessary to bring about production of these products. The Britamoil forecast of pentanes plus production compares very closely with the Board forecast for the same fields or areas.

Since the forecast submitted by Purvin & Gertz Inc., on behalf of Hydrocarbons, was adopted from the Britamoil study, a further comparison between it and the Board study is not necessary.

A comparison between the Board studies and the forecast presented by Fish Northwest Constructors, on behalf of Provincial Products, has been made, bearing in mind that the Fish Northwest forecast does not include Swan Hills and other

small fields included in the Board study. This comparison reveals that the forecasts are fairly close in the early years, but the production as forecasted by Fish Northwest does not decline sufficiently to reflect the retrograde effects anticipated for many pools by the Board and by those responsible for each of the previously discussed forecasts. The pentanes plus production as predicted by Fish Northwest compares fairly closely with the production as forecasted by the Board for comparable fields and areas.

Production of Natural Gas Liquids
from Gas Reserves not yet Discovered

Dr. Sproule, in his testimony on behalf of Westalta, stated that most of the presently known wet gas reserves in the area of his study occur in the formations of the Mississippian sediments and he expected this to hold true for future discoveries. The gas reserves of fields in this area at that time were about 61 per cent from Mississippian rocks, 34 per cent from the Devonian and only 5 per cent Mesozoic. Based on evidence to date, Dr. Sproule considered the weathered and eroded fringes of the Mississippian formations east of the foothills and the large folded and fault block type Mississippian reserves of the foothills area to be the best prospect for future discoveries since these reservoirs appear less difficult to find than the deeply buried reef type reservoirs of the Devonian in that area. Dr. Sproule also mentioned the possibility of the

discovery of multiple production horizons by wells drilled into the thick stratigraphic section of the foothills and nearby region.

Mr. G. A. Van Wielingen also of J. C. Sproule & Associates presented on behalf of Westalta a twenty-year forecast of liquid production from gas reserves not yet discovered.

In his submission, total natural gas liquid production from these reserves is estimated to begin in 1962 at a rate of some 26,000 barrels per day and to increase steadily to a rate of over 200,000 barrels per day by 1981. The propane production from this source is estimated to increase from about 4,900 barrels per day in 1962 to some 50,000 barrels per day by 1981. Similarly he forecasted butanes production from yet to be discovered gas reserves will increase from about 4,800 barrels per day in 1962 to some 48,000 barrels per day by 1981. The pentanes plus production from this same source, as forecasted by Mr. Van Wielingen, will increase from about 16,000 barrels per day to greater than 110,000 barrels per day over the period of the forecast.

In general, the forecast as prepared for the Westalta group has been based on the following assumptions:

1. Wildcat wells will be drilled at the rate of 400 per year over the twenty-year period of the forecast.
2. The gas discovery rate on the basis of initial disposable reserves will be 7.41 billion cubic feet for each wildcat well drilled.

3. Gas surplus to Alberta's requirements will be removed from the Province at the rate of one million cubic feet per day for each ten billion cubic feet of gas available, beginning in the first full calendar year after the date of discovery. (Under cross-examination regarding the rather brief time lapse between the date of discovery and the date of initial removal, Mr. Van Wielingen stated that it is possible that this time lag should be extended to from one to two years.)
4. Gas produced from undiscovered reserves for Alberta's requirements will yield 25 barrels of total liquids per million cubic feet of gas produced over the period of the forecast. This ratio was based on the present producing ratio as estimated by Sproule, for all gas produced for provincial use.
5. Gas to go to extraprovincial markets from as yet to be discovered reserves will be produced at a recoverable total liquid ratio of 40 barrels per million cubic feet of gas in 1962, increasing to 60 barrels per million by 1972, and remaining constant thereafter. This ratio was based on the present recoverable ratio as estimated by Sproule, for the gas fields included in the Alberta and

Southern Gas Co. Ltd. permits for removal of gas.

The Stanford Research Institute, on behalf of Britamoil, presented a forecast of liquid production from reserves not yet discovered, for the two years 1965 and 1970.

The total liquid production from this source, as estimated by the Stanford Research Institute for the year 1965 will range from a minimum of some 10,800 barrels per day to a maximum of about 19,500 barrels per day. The minimum production reflects the extraction of that part of the liquid components which must be removed for the residue gas to meet pipe line specifications, while the maximum production reflects the maximum amount of liquids that can economically be extracted up to the point where the residue gas will meet minimum pipe line calorific standards. The forecast shows that liquid production for the year 1970 will range from a minimum of some 39,000 barrels per day to a maximum of over 68,000 barrels per day. Expressed in terms of individual components, the forecasted propane production from undiscovered reserves will range from 800 to 5,800 barrels per day in 1965 and will increase to some 3,700 to 20,000 barrels per day by 1970. Similarly the butanes production as forecasted by Stanford Research Institute will increase from the range of 700 to 4,400 barrels per day in 1965 to the range of 3,200 to 15,000 barrels per day by 1970. The forecasted pentanes plus production from this source will increase from some 9,400 barrels per day in 1965 to about 32,000 barrels per

day in 1970. Since essentially all pentanes plus must be removed from raw gas in order to meet pipe line specifications, there is no minimum to maximum recovery range for this product.

In brief, this forecast as submitted on behalf of Britamoil was prepared in the following manner:

1. The gas production was based on a market potential study for gas and oil from Alberta, rather than on a study of the reserves to be discovered in the Province.
2. The liquid content of the future gas reserves was based on a detailed study of the liquid content of existing gas reserves.
3. The recovery of these various liquid components was based on residue gas pipe line standards and reflects both a minimum and a maximum recovery situation.

Purvin & Gertz Inc., on behalf of Hydrocarbons also presented the Board with a projection of liquid production from reserves not yet discovered, covering the period 1962 to 1971 inclusive.

It was estimated that these liquids will be produced beginning in 1962 at a rate of some 12,700 barrels per day, and that production will increase to about 108,000 barrels per day by 1971. The propane portion of this production will increase from about 1,100 barrels per day in 1962 to some 9,500 barrels per day in 1971, and the butanes prod-

uction will increase from about 1,500 barrels per day to some 13,000 barrels per day over the same period. The pentanes plus production from reserves not yet discovered, as forecasted by Purvin & Gertz, will increase from 10,000 barrels daily to over 85,000 barrels per day by the last year of the forecast.

The following are the general assumptions that formed the basis for the forecast prepared and presented to the Board by Purvin & Gertz:

1. Wildcat wells will be drilled at the rate of 400 wells per year over the period of the forecast.
2. All gas reserves discovered will be produced at the rate of one million cubic feet per day for each ten billion cubic feet discovered, beginning in the second full calendar year after the date of discovery.
3. Gas production from these yet to be discovered reserves will yield 3.64 barrels of propane, 5.08 barrels of butanes and 32.73 barrels of pentanes plus for each million cubic feet of residue gas produced. These ratios were based on the producing ratios as forecasted by Purvin & Gertz for the year 1963 for gas from the fields included in the Alberta and Southern Gas Co. Ltd. and Westcoast Transmission Company Limited permits.

Mr. R. R. McDaniel of McDaniel Consultants Ltd., appearing on behalf of Provincial Products, presented to the Board a forecast of pentanes plus production from gas reserves yet to be discovered for the period 1962 to 1971 inclusive.

The pentanes plus production from this particular source, as forecasted by McDaniel, will increase from some 10,900 barrels per day in 1962 to about 38,000 barrels per day in 1971.

The following is a resume of the assumptions that formed the basis for the forecast prepared by McDaniel:

1. 400 wildcat wells will be drilled each year over the period of the forecast.
2. Gas surplus to Alberta's requirements and to a portion of Canada's requirements will be produced at the rate of one million cubic feet per day for each ten billion cubic feet of gas available. A special "hold-back" or reservation of two trillion cubic feet at all times was employed to allow for field development.
3. The recoverable pentanes plus ratio for these yet to be discovered gas reserves was estimated at 25 barrels per million cubic feet of residue gas produced. This ratio was based on a study of the ratio for existing reserves, and reflects the fact that future drilling will likely be concentrated in areas where the average liquid content of the gas is generally higher, and that as the wet gas

reservoirs are depleted the heavier liquid recoveries usually decline.

The Board concurs with each of the applicants, that in general terms, in preparing an estimate of the liquid production from gas reserves not yet discovered it is necessary to:

(a) predict the discovery rate for natural gas reserves,

(b) predict the manner in which these reserves will be produced, and

(c) estimate the recoveries of the natural gas liquids from the future gas.

To predict the discovery rate for natural gas reserves, the Board has prepared and presents Figure A-1 "Anticipated Future Reserves". The figure has been prepared by the statistical method of estimating growth of reserves as outlined in detail in the Board's December 1959 "Report to the Lieutenant Governor in Council". It presents the total reserves expected to result from new discoveries and from the appreciation of known reserves over the next ten years. It has been prepared on the basis of a decline in the annual number of wildcat wells being drilled and on a conservative appreciation rate. The decline has been estimated as from the 400 wells per year established as the current rate on the basis of history, to about 300 wells per year by the year 1970. The average drilling rate over this period as forecast by the Board will be approximately 350 wells per year.

In order to predict the way in which these new gas reserves will be produced, the Board has studied in detail the manner in which future reserves will be called on to help meet provincial requirements and the manner in which the gas surplus to these requirements may be removed from the Province. The following assumptions have formed the basis for this study:

1. Full effective protection for Alberta's thirty-year gas requirements must be maintained.
2. All gas surplus to Alberta's requirements will be produced for other markets at the rate of one million cubic feet per day for each ten billion cubic feet of surplus reserves, beginning in the fourth full calendar year after the date of discovery. This time lag which in fact averages three and one-half years, is intended to reflect the time necessary to develop the reserves, to obtain the necessary governmental approvals, and to develop additional markets for Alberta gas.

The detailed study carried out by the Board indicated that the combined production rate - reserve ratio for new gas reserves (serving both the provincial market and the extra-provincial market) will vary slightly from year to year over the next ten years, but will average one million cubic feet of daily production for each thirteen billion cubic feet of reserves developed. This average overall producing rate, along with the previously discussed time lag of three and

one-half years has been adopted for the sake of simplicity.

To estimate the recoverable natural gas liquids of these future gas discoveries, the Board has carried out a detailed investigation of all available evidence on this matter. The main factors considered by the Board were as follows:

(a) the average liquid ratios for current gas production,

(b) the average liquid ratios for established reserves,

(c) the manner in which these liquid ratios are increasing or decreasing with new discoveries, and

(d) the manner in which these ratios are declining with production as a result of retrograde effects in certain pools.

After a detailed study of the recoverable liquid ratios for established gas reserves by year of discovery, the Board has concluded that the initial liquid ratios for gas discoveries of succeeding years are increasing slightly. These increases are the result of more drilling in the foothills region where generally speaking the gas contains greater amounts of the higher hydrocarbons. On the basis of this study, the Board has estimated that the initial recoverable propane ratio for gas discovered during 1960 will be 4.0 barrels per million cubic feet under the present economic

conditions. If conditions of increased economic incentive to recover propane should occur, the initial recoverable ratio for gas discovered during 1960 would then be estimated at 5.8 barrels per million cubic feet. It has also been estimated that in either case these initial ratios will increase for the discoveries of each succeeding year, by 0.1 barrels per million cubic feet per year over the period of the forecast. Similarily, the "minimum" and "maximum" recoverable butanes ratios for the 1960 gas discoveries have been estimated at 3.5 and 5.5 barrels per million cubic feet respectively. These ratios are estimated to increase for the discoveries of each succeeding year, at the rate of 0.1 barrels per million cubic feet per year. It has also been estimated that the initial recoverable pentanes plus ratio for the 1960 gas discoveries will be 22.0 barrels per million cubic feet, and that this ratio will increase at the rate of 1.0 barrel per million cubic feet per year for new gas discoveries. This ratio should not be significantly affected by changes in economic conditions.

It is evident, that due to the retrograde effects in many pools, the average producing liquid ratio for any particular year's gas discoveries will decline with production. The Board has recognized this situation in the preparation of its forecast and has estimated the decline for reserves not yet discovered on the basis of the decline forecast in the producing ratios for established reserves.

Table A-6, "Production of Natural Gas Liquids from Gas Reserves Not Yet Discovered" has been based on the aforementioned assumptions. The table presents the Board's forecast, on a minimum and maximum basis, of the liquids to be produced over the next thirty years from the gas reserves that the Board predicts will be discovered during the ten-year period, 1961 to 1970 inclusive. Column 1 of the table shows the year and column 2 of the table shows the annual growth in gas reserves expected for the initial ten years of the forecast. This growth has been determined from Figure A-1. Column 3 gives the thirty-year forecast of gas production from these new reserves, deferred four years and based on the producing ratio of one million cubic feet per day for each thirteen billion cubic feet of reserves. Columns 4, 5, 6, 7, 8 and 9 represent the minimum and maximum liquids produced in association with this gas and are arrived at by multiplying the gas production set out in column 3 by the appropriate recoverable liquid to gas ratios.

The table indicates that propane production from gas to be discovered during the next ten years, as forecast by the Board, under present economic conditions, will peak at over 8,200 barrels per day in 1974 and then decline to some 6,400 barrels per day by 1990. Under conditions of increased economic incentive to recover this product, this propane production is estimated to peak at over 12,000 barrels per day in 1974 and to decline thereafter to about 9,500 barrels

per day by 1990. The butanes production from the same source has been estimated at about 7,000 barrels per day in 1974, declining to some 4,900 barrels per day by 1990, under present economic conditions. Under conditions of increased economic incentive this production is estimated to peak at about 11,400 barrels per day in 1974, and to decline to some 8,300 barrels per day by 1990. The pentanes plus production from the same ten years gas discoveries, is estimated to peak at over 47,000 barrels per day in 1974 and to decline to less than 30,000 barrels per day by 1990, regardless of changes in the economic conditions.

Table A-7 presents a comparison of the liquid production from gas reserves not yet discovered, as estimated by the Board and as estimated in each of the submissions made to the Board at the hearings.

A detailed study of Table A-7 shows that the liquid production as forecasted by J. C. Sproule & Associates, on behalf of the Foothills group, is much higher than that forecasted by the Board, even under maximum recovery conditions. One major reason for this difference is that the gas production from reserves not yet discovered as estimated by the Sproule study is much greater than as estimated in the Board study. This is mainly because the Board forecasts the drilling of an average of 350 wildcat wells per year over the next ten years as compared to a drilling rate estimated by Sproule of 400 wildcat wells per year. It is also partially due to the

Board's estimate that there will be a time lag equal to three and one-half years on the average between the date of discovery and the date of initial production, while the Sproule forecast reflects an average time lag of only one-half year. Another major reason for the difference in the forecast is that the Sproule study estimates that the recoverable liquid ratios will increase by about one and one-half times over the next ten years due to increased drilling in the foothills region. As previously mentioned, the Board has studied in detail this trend towards increasing recoverable liquid ratios and concludes that the slight increase that is indicated for the future will be virtually offset by the decline in these ratios with production due to retrograde effects.

A comparison between the Board forecast and the forecast submitted by Stanford Research Institute on behalf of Britamoil shows that both the minimum and maximum Board estimates for propane and butanes lie between the minimum and maximum estimates submitted by Stanford, while the pentanes plus forecast compares very closely. Bearing in mind the definition of minimum and maximum as used by Stanford, this result of the comparison is to be expected. Table A-7 also reveals that the liquid production from yet to be discovered reserves as forecasted for Hydrocarbons by Purvin & Gertz Inc. is generally higher than as forecasted by the Board, particularly for butanes and pentanes plus. This difference results mainly from a disagreement in the estimates of future gas production

from reserves not yet discovered. The Purvin & Gertz submission is based on the assumption that all future gas discoveries will be produced at the daily rate of one million cubic feet for each ten billion cubic feet of reserves developed, while the Board believes that some portion of these new reserves will be set aside to meet a projected growth in the Province's thirty-year requirements. Since this gas set aside for Alberta's requirements will be produced at a lesser rate than gas for other markets, the net result as previously mentioned is that, in the Board's estimation, the overall producing rate will be about one million cubic feet per day for each thirteen billion cubic feet of gas developed. In addition to this, the Purvin & Gertz forecast is based on the drilling of 400 wildcat wells per year as compared to the average drilling rate of 350 wildcat wells per year forecasted by the Board. The recoverable liquid ratio as forecasted by Purvin & Gertz is comparable to the minimum recovery ratio estimated by the Board for propane, and the maximum recovery ratio estimated for butanes, but is considerably higher for pentanes plus. Purvin & Gertz assumed the ratios to remain constant throughout the next ten years.

A comparison between the Provincial Products' forecast submitted by Mr. R. R. McDaniel and the Board's forecast of pentanes plus production reveals that the McDaniel estimates are higher than the Board's, particularly in the early years of the forecast. This is mainly because the McDaniel study

has been based on the drilling of 400 wildcat wells per year, and also because he assumed the equivalent of a lag between time of discovery and initial production of approximately one year as compared to the three and one-half years estimated by the Board.

Reserves of Natural Gas Liquids

Although essentially all gas reserves in the Province contain at least traces of propane and higher hydrocarbons, only a portion of the reserves contain these liquids in sufficient quantity to justify their economic recovery. For this reason a liquid reserve study which included pools where the reserves are not economically recoverable would be meaningless.

J. C. Sproule & Associates, appearing on behalf of the Foothills group, estimated the recoverable liquid reserves, as of September 1, 1960, for the area with which they were concerned to be 572.4 million barrels. This is made up of 99.5 million barrels of propane, 115.4 million barrels of butanes and 357.5 million barrels of pentanes plus. The area considered in the Sproule study is the south-western part of Alberta from the International boundary north to the approximate latitude of Lesser Slave Lake. It is roughly triangular in shape, covering little more than the narrow foothills belt at the eastern edge of the Rocky Mountains at the International boundary, and widening to over a hundred miles

in width in the northern part.

Since the effective reserves of natural gas liquids should include only the economically recoverable liquids, it follows that a study of the reserves need be concerned only with the fields or areas listed in Tables A-1, A-2 and A-3. Table A-8, "Recoverable Reserves of Natural Gas Liquids" has been prepared by averaging the recovery ratios for each pool in the forecast over the life of the pool and by multiplying the resulting average ratio by the gas reserves for the pool. Column 1 of the table sets out the location of the reserve either by field, area or where the composite of more than one field exists by plant name. Column 2 indicates the producing zone or zones. Column 3 is the total remaining disposable gas reserve for the pools designated in columns 1 and 2. These reserves have been taken from Table 1 of the Board's report "Reserves of Natural Gas, Natural Gas Liquids and Crude Oil of the Province of Alberta", dated March, 1961. Columns 4, 5 and 6 are a tabulation of the average liquid recovery factors as determined for the life of each pool from Tables A-1, A-2 and A-3. Columns 7, 8 and 9 are the product of column 3 and columns 4, 5 and 6 and are the recoverable liquid reserves for each field, area or plant.

Table A-8 also includes a supplementary listing which shows the additional recoverable propane and butane reserves that may be recovered as a result of the reprocessing of pipe line gas and the additional reserves that exist if the

situation of increased economic incentive actually occurs.

It can be seen from the table that the recoverable propane reserves as estimated by the Board are some 122 million barrels or some 165 million barrels under conditions of increased economic incentive. The butane reserves are some 96 million barrels or 136 million barrels with the additional economic incentive. The recoverable pentanes plus reserves are some 411 million barrels and this figure should not be significantly affected by changes in the economic situation.

The Board's estimated recoverable reserves are also shown on Figure A-2, a map of the Province. The map shows the approximate eastern edge of the foothills belt and the portion of the Province underlain by Mississippian rock. The Devonian underlying the Mississippian extends also over the entire map area. It will be observed that the location of fields with recoverable reserves of over five million barrels of natural gas liquids are concentrated chiefly in the western part of the Province.

A comparison of the reserves as estimated by Sproule and by the Board, can be made only after adjusting the Sproule estimates to cover all pools and the entire Province rather than a limited number of pools in the south-west portion of the Province. Adding to the Sproule estimates for selected pools in south-western Alberta the Board's estimates for all other pools in the Province, reserves of

about 188 million barrels of propane, 170 million barrels of butanes and 430 million barrels of pentanes plus are obtained. This means that for individual fields the reserves as estimated by Sproule are greater than as estimated by the Board, particularly for propane and butanes. One reason for this is that the gas reserves for individual fields as estimated by Sproule are very often higher than those estimated by the Board. Another reason, particularly for propane and butanes is that, as previously discussed, the Sproule study generally assumes very high per cent recoveries for these two products.

ADDENDUM TO APPENDIX A

Since the preparation of this appendix, the Board has heard representations concerning a pipe line application of Royalite Oil Company, Limited, for a permit to construct a gas products line from the Wildcat Hills area to the Calgary area. At the hearing, Mr. J. W. Gregg of James A. Lewis Engineering, Ltd., presented on behalf of Royalite a liquid production forecast and reserve estimate for the fields of Jumping Pound, Sarcee and Wildcat Hills.

As a result of Mr. Gregg's evidence, the Board has reviewed the pentanes plus production forecast and reserve estimate for these fields. The main issue raised by this evidence is of the impact of retrograde effects on the production from the fields, particularly Sarcee and Wildcat Hills.

A review of the estimated production and reserves for the individual fields, indicates that no change is warranted in the production forecast or the reserve estimate for Jumping Pound. In the case of the Sarcee Field, the Board now believes that the pentanes plus production may be as much as one hundred barrels per day greater than previously forecast for the initial years, and will likely decline quite rapidly from about 1965 through 1980. The Board does not believe that this change in the production pattern will affect the reserve estimate for the field, as has been presented in Table A-8. A restudy of the

Wildcat Hills Field, in the light of evidence now available, indicates that this pool definitely appears to be a retrograde-condensate type reservoir. The Board believes that the estimated initial full capacity production of some 680 barrels of liquids per day will begin to decline about 1966, and will be about 550 barrels per day by 1970, about 450 barrels per day by 1980, and about 200 barrels per day by 1990. These retrograde losses will lower the estimated recoverable reserves for this pool, from the 6.9 million barrels shown in Table A-8 to some 5.7 million barrels.

The overall effect of these changes on the Board's pentanes plus production forecast will be insignificant. The revised total production would be slightly higher than that shown on Table A-3, until about 1966. It would be about the same from then until 1970, and would be lower (by up to 200 barrels per day) thereafter.

The total reduction in the liquid reserve estimate would be 1.2 million barrels, and would lower the estimated pentanes plus reserves from some 411 million barrels to some 410 million barrels. This would decrease the total recoverable liquid reserves to about 628 million barrels under minimum recovery conditions or about 711 million barrels under maximum recovery conditions.

TABLE A - 1

OIL AND GAS CONSERVATION BOARD

FORECAST OF PROPANE PRODUCTION FROM ESTABLISHED GAS RESERVES (Barrels/Day)

FIELD OR AREA	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
ACHESON	215	270	270	270	270	270	270	270	270	270	260	240	210	175	155	145	135	125	120	115	110	105	100	95	90	85	80	75	70	65
BONNIE GLEN (1)	830	1035	1045	1055	1060	1065	1070	1075	1080	1085	1080	1070	1060	1050	1045	1040	1035	1030	1030	1025	1020	1020	1020	1015	1015	1010	1010	1005	1005	1000
CARSON CREEK					70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	65	60	55	50	45	45	40	35	30	25	25
HOMEGLEN RIMBEY	200	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	350	330	295	250	215	185	155	135	120	105	95	85
KAYBOB		100	160	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165	165	150	135	120	105	90	80	65	50
LEDUC WOODBEND	840	820	800	780	740	680	620	580	540	500	460	420	380	340	300	240	160	470	470	470	470	470	470	470	470	470	470	470	470	470
LONE PINE CREEK					40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	35	30	30	25	20
LOOKOUT BUTTE					220	220	220	220	210	200	190	180	170	160	150	140	130	120	110	110	110	110	110	110	110	110	110	110	110	110
NEVIS	330	380	425	430	440	455	480	500	520	540	555	570	585	595	600	595	585	575	560	530	495	475	460	440	420	390	370	350	330	310
OLDS			75	75	75	75	75	75	75	70	70	65	65	65	60	60	55	55	50	50	45	45	40	40	35	35	35	30	30	30
PEMBINA	1300	1150	1165	1180	1200	1180	1160	1140	1120	1100	1070	1040	1000	960	920	880	840	790	740	690	640	590	550	510	470	430	390	360	330	300
PINCHER CREEK	500	580	600	570	550	530	510	495	475	490	525	575	625	675	725	800	830	840	830	805	775	740	720	700	680	660	640	620	600	580
REDWATER	330	445	460	460	460	460	460	460	460	460	460	460	460	455	450	440	430	420	405	390	375	360	345	330	315	300	285	270	255	240
SIMONETTE					80	80	80	80	80	80	80	80	80	75	75	75	75	75	70	70	70	70	70	65	65	60	60	55	50	50
SWAN HILLS (2)			1810	2030	2170	2340	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1990	1940	1900	1850	1810	1760	1720	1670	1630	1590	1540
SYLVAN LAKE					325	325	325	325	325	325	325	325	325	325	325	325	325	325	325	320	315	305	295	285	275	265	255	245	235	225
TURNER VALLEY	340	385	450	450	440	415	340	295	265	235	205	175	150	130	110	90	75	60	45	30	15									
WESTEROSE SOUTH	490	1170	1205	1195	1185	1180	1170	1165	1160	1150	1145	1135	1125	1115	1105	1085	1000	880	750	620	520	430	360	310	270	230				
WIMBORNE		90	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	95	90	85	80	80	75	70	65	60	60	55	55	50
SUB-TOTAL	5375	6775	8910	9105	9935	10000	9490	9390	9290	9215	9135	9045	8945	8925	8730	8625	8385	8475	8210	7900	7540	7210	6920	6755	6400	6140	5710	5520	5340	5150
ADDITIONAL PRODUCTION EXPECTED FROM THE REPROCESSING OF PIPELINE GAS FOR PETROCHEMICAL PURPOSES																														
	350	350	350	600	900	1000	1000	1000	1000	1500	1500	1500	1500	1500	1500	1500	1500	1500	1450	1400	1350	1300	1250	1200	1150	1100	1050	1000	950	900
TOTAL	5725	7125	9260	9705	10835	11000	10490	10390	10290	10715	10635	10545	10445	10425	10230	10125	9885	9975	9660	9300	8890	8510	8170	7955	7550	7240	6760	6520	6290	6050
ADDITIONAL PRODUCTION THAT MAY RESULT FROM INCREASED ECONOMIC INCENTIVE TO RECOVER PROPANE																														
INCREASED PRODUCTION (3)				460	660	660	660	660	660	660	660	650	650	640	640	640	630	630	620	610	600	590	570	550	530	510	490	470	450	430
CALGARY				215	215	225	250	260	275	290	300	310	310	310	310	310	330	330	330	330	330	330	330	330	330	330	330	330	330	330
CARSTAIRS				575	575	575	575	575	575	575	575	575	575	575	575	575	570	540	510	470	430	395	355	320	285	245	215	190	170	155
CROSSFIELD				400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	395	370	345	325	305	290
GILBY				120	120	120	120	120	120	120	120	120	120	120	120	115	110	100	90	80	75	70	60	55	50	45	40	35	30	30
MINNEHIK BUCK LAKE				180	180	180	180	180	180	180	180	165	150	135	120	105	90	80	70	60	55	50	45	40	35	30	25			
WATERTON				350	350	345	345	340	340	340	340	340	340	340	340	340	340	345	345	345	340	320	300	280	260	240	210	180	160	160
WINDFALL				1320	1260	1180	1090	995	900	800	730	650	580	510	400	200	200	200	200	200	200	200	200	200	200	200	180	160	150	140
SUB-TOTAL				3620	3760	3685	3620	3480	3450	3365	3305	3210	3125	3030	2905	2685	2670	2625	2565	2495	2430	2355	2260	2175	2085	1970	1835	1690	1595	1535
TOTAL	5725	7125	9260	13325	14595	14685	14110	13870	13740	14080	13940	13755	13570	13455	13135	12810	12555	12600	12225	11795	11320	10865	10430	10130	9635	9210	8595	8210	7885	7585

(1) INCLUDES BONNIE GLEN, GLEN PARK AND WIZARD LAKE.

(2) INCLUDES CARSON CREEK NORTH, JUDY CREEK, JUDY CREEK WEST, SWAN HILLS AND VIRGINIA HILLS.

(3) INCREASED PRODUCTION FROM FIELDS IN UPPER HALF OF TABLE.

TABLE A - 2

OIL AND GAS CONSERVATION BOARD

FORECAST OF BUTANE PRODUCTION FROM ESTABLISHED GAS RESERVES (Barrels/Day)

FIELD OR AREA	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Acheson	115	145	145	145	145	145	145	145	145	145	135	125	110	95	80	75	70	65	65	60	60	55	55	50	45	45	45	40	40	35
Bonnie Glen (1)	580	710	715	715	715	715	715	715	715	710	705	700	695	690	685	680	675	670	665	660	655	650	645	640	635	630	625	620	615	610
Carson Creek					80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	75	70	65	60	55	50	45	40	35	30	25
Homeglen Rimbey	310	555	555	555	555	555	555	555	555	555	555	555	555	555	555	555	555	555	555	535	475	405	345	295	250	220	190	165	145	125
Kaybob		120	180	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	185	170	155	140	125	110	100	85	70
Leduc Woodbend	660	630	600	570	540	510	480	450	420	400	380	360	340	320	270	170	150	320	320	320	320	320	320	320	320	320	320	320	320	320
Lone Pine Creek					60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	55	50	45	40	35	30
Lookout Butte					320	320	320	320	305	290	275	260	245	230	215	200	185	165	165	165	165	165	165	165	165	165	165	165	165	165
Nevis	265	305	340	345	350	365	385	400	415	430	445	455	465	475	480	475	470	460	445	425	395	380	360	350	335	315	295	280	265	250
Olds			85	85	85	85	85	85	80	80	80	75	75	75	70	70	70	65	65	65	60	60	55	55	50	50	45	45	40	40
Pembina	975	860	875	885	900	885	865	850	835	820	790	775	745	715	680	650	620	585	545	510	475	440	405	375	335	310	285	260	235	215
Pincher Creek	690	900	915	870	840	810	780	745	730	745	780	830	860	880	890	900	910	870	830	800	770	740	710	680	650	620	590	560	530	500
Redwater	300	410	425	425	425	425	425	425	425	425	425	425	425	420	415	405	395	385	375	360	345	330	320	305	290	275	265	250	235	220
Simonette					150	145	140	135	135	130	130	125	125	125	125	125	125	125	125	125	125	125	120	115	105	90	80	75	70	65
Swan Hills (2)			890	1000	1060	1150	980	980	980	980	980	980	980	980	980	980	980	980	980	980	950	930	910	890	870	840	820	800	780	760
Sylvan Lake					240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	235	230	225	220	210	200	195	185	180	175	165
Westerose South	700	1640	1670	1650	1630	1610	1600	1590	1580	1570	1560	1540	1520	1500	1470	1420	1320	1190	940	800	670	560	480	420	370	320				
Wimborne		185	205	220	220	220	220	215	215	215	215	210	210	210	210	210	205	200	190	180	170	165	155	150	140	130	125	120	115	110
SUB-TOTAL	4595	6460	7600	7650	8500	8505	8260	8175	8100	8060	8020	7980	7915	7835	7690	7480	7295	7200	6830	6540	6180	5860	5555	5290	5010	4745	4230	4055	3900	3705
ADDITIONAL PRODUCTION EXPECTED FROM THE REPROCESSING OF PIPELINE GAS FOR PETROCHEMICAL PURPOSES																														
				200	400	600	600	600	600	800	800	800	800	800	800	800	800	800	775	750	725	700	675	650	625	600	575	550	525	500
TOTAL	4595	6460	7600	7850	8900	9105	8860	8775	8700	8860	8820	8780	8715	8635	8490	8280	8095	8000	7605	7290	6905	6560	6230	5940	5635	5345	4805	4605	4425	4205
ADDITIONAL PRODUCTION THAT MAY RESULT FROM INCREASED ECONOMIC INCENTIVE TO RECOVER BUTANES																														
Increased Production (3)				300	420	420	420	420	420	420	420	415	410	405	405	400	400	395	395	390	380	370	360	350	340	330	315	300	285	270
Calgary				310	310	330	365	385	400	410	430	430	430	430	430	430	460	460	460	460	460	460	460	460	460	460	460	460	460	460
Carstairs				570	570	570	570	570	570	570	570	570	570	570	570	570	570	535	500	465	430	395	360	325	290	260	230	200	170	140
Crossfield				405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	405	400	375	350	330	310	295
Gilby				125	125	125	125	125	125	125	125	125	125	125	125	120	115	105	95	85	75	70	60	55	50	45	40	35	30	30
Minnehik Buck Lake				260	260	260	260	260	260	260	235	235	210	190	170	150	130	110	90	80	70	60	50	45	40	35	30			
Waterton				360	355	350	345	340	340	335	335	330	330	325	325	320	320	320	320	320	310	300	280	260	240	220	195	170	145	120
Windfall				2310	2205	2060	1900	1750	1560	1390	1220	1050	900	750	500	280	280	280	280	280	280	280	280	280	280	260	250	240	225
SUB-TOTAL				4640	4650	4520	4390	4255	4080	3915	3740	3560	3380	3200	2930	2675	2680	2610	2545	2485	2410	2340	2255	2180	2100	2005	1880	1745	1640	1540
TOTAL	4595	6460	7600	12490	13550	13625	13250	13030	12780	12775	12560	12340	12095	11835	11420	10955	10775	10610	10150	9775	9315	8900	8485	8120	7735	7350	6685	6350	6065	5745

(1) Includes Bonnie Glen, Glen Park and Wizard Lake.

(2) Includes Carson Creek North, Judy Creek, Judy Creek West, Swan Hills and Virginia Hills.

(3) Increased production from fields in upper half of table.

TABLE A - 3

OIL AND GAS CONSERVATION BOARD

FORECAST OF PENTANES PLUS PRODUCTION FROM ESTABLISHED GAS RESERVES (Barrels/Day)

FIELD OR AREA	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
ACHESON	60	75	75	75	75	75	75	75	75	75	70	65	60	50	45	40	40	35	35	30	30	30	30	30	25	25	20	20	20	20
ALEXANDER	140	120	60	25																										
BEAVER CREEK														130	130	130	130	130	130	130	130	130	130	130	125	120	110	105	100	95
BONNIE GLEN (1)	585	720	725	725	725	725	725	725	725	720	720	715	715	710	710	710	705	705	700	700	700	695	695	690	690	685	685	680	675	670
BURNT TIMBER					130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	130	125	125	120	120	120	115	115
CALGARY	600	1850	1830	1820	1790	1860	2030	2050	2120	2160	2200	2200	2150	2090	2040	2000	2000	2000	2000	2000	1970	1940	1920	1890	1870	1840	1820	1790	1770	1750
CARSON CREEK					530	530	525	525	520	520	515	510	510	505	505	500	500	495	490	460	435	405	370	340	310	280	255	280	205	190
CARSTAIRS	1770	2180	2490	2460	2420	2370	2340	2310	2260	2220	2180	2150	2110	2090	2060	2030	2000	1860	1480	1240	1040	860	700	660	560	480	400	340	290	250
CESSFORD	245	275	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	290	270	250	230	210	190	175	160	150	140	130	120
CHIGWELL	50	55	60	60	60	60	60	60	60	60	60	60	60	60	55	50	45	45	40	35	30	25	25	20	20					
CROSSFIELD		1250	1590	1550	1525	1500	1480	1465	1450	1420	1410	1380	1350	1325	1300	1275	1250	1225	1205	1185	1165	1150	1140	1130	1110	1030	970	920	890	870
GILBY	320	410	495	495	495	495	495	495	495	495	495	495	495	495	490	470	445	410	365	330	295	270	245	220	200	180	160	145	130	120
GOLDEN SPIKE	330	390	400	400	400	400	400	400	400	400	400	400	395	390	385	380	375	370	365	360	355	350	345	340	335	330	325	320	310	300
HARMATTAN EAST		1100	3000	3000	3000	3000	2800	2600	2400	2100	1900	1700	1500	1200	1000	700	700	700	700	700	700	700	700	700	700	700	700	680	660	640
HARMATTAN ELKTON		4000	4000	4000	4000	4000	3800	3500	3200	2800	2600	2400	2100	1800	1500	1200	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
HOMEGLEN RIMBEY	1850	3320	3280	3230	3190	3140	3100	3050	3010	2950	2890	2770	2650	2530	2410	2290	2170	2110	2050	1990	1670	1410	1205	1030	790	650	570	500	440	390
HUSSAR	190	220	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250	235	200	170	140	115	95	75	60	45	30	20	15
JUMPING POUND	720	700	680	650	630	600	575	550	520	495	465	440	410	385	345	300	285	270	255	245	230	210	185	175	165	160	150	140	135	125
KAYBOB		120	195	200	200	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	205	190	170	150	140	125	110	95	80
LEDUC WOODBEND	360	345	335	320	305	290	275	260	245	230	220	210	200	190	170	110	70	145	145	145	145	145	145	145	145	145	145	145	145	145
LONE PINE CREEK					120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	120	110	100	90	85	80	75	70
LOOKOUT BUTTE					2700	2700	2700	2700	2550	2400	2200	2000	1800	1600	1400	1250	1100	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
MORINVILLE	150	150	150	150	145	140	140	135	130	125	120	110	105	95	85	75	65	55	50	45	40	35	30	30	30	25	25	25	25	20
MINNEHIK BUCK LAKE	30	245	245	245	245	245	245	245	245	245	245	225	200	180	160	140	120	100	80	70	60	50	40	35	30	25	20			
NEVIS	880	1000	1100	1100	1100	1100	1130	1150	1170	1190	1200	1200	1200	1200	1200	1180	1140	1080	1010	940	850	760	720	680	640	610	580	560	530	500
OLDS			430	415	400	380	360	345	330	310	290	280	270	260	250	240	230	220	210	200	190	180	170	160	160	155	150	150	145	140
PEMBINA	1000	920	930	940	930	910	880	850	820	790	760	730	700	670	640	610	580	550	520	490	470	450	430	410	390	370	350	330	310	290
PEMBINA (LOBSTICK)				115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	115	110	105	100	95	90	85	80	75	70	65	
PINCHER CREEK	4580	5600	5590	5200	4840	4460	4140	3850	3590	3360	3090	2930	2770	2620	2460	2310	2160	2010	1860	1710	1560	1420	1290	1220	1160	1120	1080	1050	1020	990
REDWATER	120	160	165	165	165	165	165	165	165	160	160	155	150	150	145	145	140	140	135	130	125	120	120	115	110	105	100	95	90	90
SARCEE		100	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	230	225	215	205	190	180	170	160	150	140	130
SIMONETTE					2150	1750	1460	1270	1180	1070	980	890	800	720	640	580	520	480	450	410	380	360	340	330	330	335	340	345	350	355
SWAN HILLS (2)			395	445	470	510	435	435	435	435	435	435	435	435	435	435	435	435	435	435	425	415	405	395	385	375	365	355	345	335
SYLVAN LAKE					280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	280	270	265	255	245	240	230	220	210	205	195
TURNER VALLEY	1055	1200	1390	1380	1360	1295	1040	920	820	720	640	550	475	410	345	285	240	195	150	95	50									
WATERTON		2880	4260	3850	3450	3150	2910	2770	2690	2610	2520	2420	2300	2200	2100	2000	1900	1820	1750	1690	1640	1530	1410	1290	1190	1070	945	820	700	575
WESTEROSE SOUTH	2280	4650	4720	4590	4450	4310	4170	4020	3890	3750	3670	3610	3550	3490	3400	3250	3020	2610	2150	1570	1370	1180	990	870	780	690				
WILDCAT HILLS		450	450	680	680	680	680	680	680	680	680	680	680	680	680	680	680	680	660	620	580	540	500	450	400	350	300	250	200	150
WIMBORNE		1220	1280	1270	1250	1200	1160	1130	1100	1060	1020	980	950	910	875	840	805	730	670	610	550	510	480	460	440	420	400	380	360	340
WINDFALL	3000	10000	13500	13000	12000	11000	10000	9000	8000	7000	6000	5000	4000	3000	2000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	900	800	700	600
WORSLEY		450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	450	430	410	390	375	355	340	325	310	290	
OTHER SMALL FIELDS	370	460	510	510	560	560	550	550	545	530	500	470	465	465	455	440	435	420	400	375	355	320	290	270	250	230	190	180	165	155
TOTAL	20685	46615	55560	54295	58115	55680	52925	50360	47900	45160	42715	40240	37635	35245	32495	29725	28365	27105	25545	23945	22475	21035	19785	18820	17850	16915	15380	14595	13870	13185

(1) INCLUDES BONNIE GLEN, GLEN PARK AND WIZARD LAKE.

(2) INCLUDES CARSON CREEK NORTH, JUDY CREEK, JUDY CREEK WEST, SWAN HILLS AND VIRGINIA HILLS.

TABLE A - 4

OIL AND GAS CONSERVATION BOARD

PRODUCTION FORECAST OF NATURAL GAS LIQUIDS FROM ESTABLISHED RESERVES

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	PRODUCTION UNDER PRESENT ECONOMIC CONDITIONS (1) BARRELS PER DAY			PRODUCTION UNDER PRESENT ECONOMIC CONDITIONS PLUS THE REPROCESSING OF PIPELINE GAS BARRELS PER DAY			PRODUCTION UNDER MAXIMUM ECONOMIC CONDITIONS PLUS THE REPROCESSING OF PIPELINE GAS BARRELS PER DAY		
YEAR	PROPANE	BUTANES	PENTANES PLUS	PROPANE	BUTANES	PENTANES PLUS	PROPANE	BUTANES	PENTANES PLUS
1961	5375	4595	20685	5725	4595	20685	5725	4595	20685
1962	6775	6460	46615	7125	6460	46615	7125	6460	46615
1963	8910	7600	55560	9260	7600	55560	9260	7600	55560
1964	9105	7650	54295	9705	7850	54295	13325	12490	54295
1965	9935	8500	58115	10835	8900	58115	14595	13550	58115
1966	10000	8505	55680	11000	9105	55680	14685	13625	55680
1967	9490	8260	52925	10490	8860	52925	14110	13250	52925
1968	9390	8175	50360	10390	8775	50360	13870	13030	50360
1969	9290	8100	47900	10290	8700	47900	13740	12780	47900
1970	9215	8060	45160	10715	8860	45160	14080	12775	45160
1971	9135	8020	42715	10635	8820	42715	13940	12560	42715
1972	9045	7980	40240	10545	8780	40240	13755	12340	40240
1973	8945	7915	37635	10445	8715	37635	13570	12095	37635
1974	8925	7835	35245	10425	8635	35245	13455	11835	35245
1975	8730	7690	32495	10230	8490	32495	13135	11420	32495
1976	8625	7480	29725	10125	8280	29725	12810	10955	29725
1977	8385	7295	28365	9885	8095	28365	12555	10775	28365
1978	8475	7200	27105	9975	8000	27105	12600	10610	27105
1979	8210	6830	25545	9660	7605	25545	12225	10150	25545
1980	7900	6540	23945	9300	7290	23945	11795	9775	23945
1981	7540	6180	22475	8890	6905	22475	11320	9315	22475
1982	7210	5860	21035	8510	6560	21035	10865	8900	21035
1983	6920	5555	19785	8170	6230	19785	10430	8485	19785
1984	6755	5290	18820	7955	5940	18820	10130	8120	18820
1985	6400	5010	17850	7550	5635	17850	9635	7735	17850
1986	6140	4745	16915	7240	5345	16915	9210	7350	16915
1987	5710	4230	15380	6760	4805	15380	8595	6685	15380
1988	5520	4055	14595	6520	4605	14595	8210	6350	14595
1989	5340	3900	13870	6290	4425	13870	7885	6045	13870
1990	5150	3705	13185	6050	4205	13185	7585	5745	13185

(1) EXCLUDING PRODUCTION FROM PRESENT REPROCESSING OF PIPELINE GAS.

TABLE A - 5

OIL AND GAS CONSERVATION BOARD

COMPARISON OF NATURAL GAS LIQUIDS PRODUCTION FORECAST AS PREPARED BY THE BOARD AND BY VARIOUS APPLICANTS

(BARRELS PER DAY)

YEAR	PRODUCT	BOARD STUDY (WITH NO ADDITIONAL INCENTIVE)	BOARD STUDY (WITH NO ADDITIONAL INCENTIVE BUT WITH PIPELINE GAS REPROCESSING)	BOARD STUDY (WITH ADDITIONAL INCENTIVE AND PIPELINE GAS REPROCESSING)	FOOTHILLS PIPE LINES LTD. AND WESTALTA PRODUCTS PIPE LINE LTD. (1)	BRITAMOIL PIPE LINE COMPANY LIMITED AND HYDROCARBONS PIPELINE LIMITED (2)	PROVINCIAL PRODUCTS PIPELINES LIMITED (3)
1962	PROPANE	6775	7125	7125	12045	8715	9611
	BUTANES	6460	6460	6460	12004	9526	9740
	PENTANES PLUS	46615	46615	46615	41009	46549	49244
1965	PROPANE	9935	10835	14595	12286	9117	10502
	BUTANES	8500	8900	13550	12580	10115	10837
	PENTANES PLUS	58115	58115	58115	41178	54884	53465
1970	PROPANE	9215	10715	14080	10523	7874	10196
	BUTANES	8060	8860	12775	10462	8402	10712
	PENTANES PLUS	45160	45160	45160	28711	42574	45799
1980	PROPANE	7900	9300	11795	8470	N.A.	N.A.
	BUTANES	6540	7290	9775	8226	N.A.	N.A.
	PENTANES PLUS	23945	23945	23945	16041	N.A.	N.A.

(1) ESTIMATES DO NOT INCLUDE HARMATTAN EAST, HARMATTAN ELKTON, LOOKOUT BUTTE, SWAN HILLS AND OTHER SMALL FIELDS.

(2) ESTIMATES DO NOT INCLUDE SWAN HILLS AND OTHER SMALL FIELDS.

(3) ESTIMATES DO NOT INCLUDE SWAN HILLS AND OTHER SMALL FIELDS.

TABLE A - 6

OIL AND GAS CONSERVATION BOARD

PRODUCTION OF NATURAL GAS LIQUIDS FROM GAS RESERVES NOT YET DISCOVERED

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
YEAR	GROWTH IN RESERVES OVER PREVIOUS YEAR BCF	TOTAL GAS PRODUCTION FROM RESERVES SHOWN IN COLUMN 2 (1) BCF	MINIMUM PROPANE PRODUCTION BARRELS PER DAY	MINIMUM BUTANES PRODUCTION BARRELS PER DAY	MINIMUM PENTANES PLUS PRODUCTION BARRELS PER DAY	MAXIMUM PROPANE PRODUCTION BARRELS PER DAY	MAXIMUM BUTANES PRODUCTION BARRELS PER DAY	MAXIMUM PENTANES PLUS PRODUCTION BARRELS PER DAY
1960	3660 (2)	-	-	-	-	-	-	-
1961	2560	-	-	-	-	-	-	-
1962	2530	-	-	-	-	-	-	-
1963	2480	-	-	-	-	-	-	-
1964	2410	282	1125	990	6200	1635	1550	6200
1965	2330	479	1920	1680	10700	2790	2650	10700
1966	2270	673	2710	2355	15260	3945	3740	15260
1967	2160	864	3500	3030	19860	5105	4825	19860
1968	2060	1049	4270	3695	24500	6225	5905	24500
1969	1960	1228	5005	4310	28660	7315	6945	28660
1970	1870	1402	5745	4935	32780	8395	7940	32780
1971		1568	6425	5505	36690	9400	8900	36690
1972		1727	7075	6035	40440	10375	9805	40440
1973		1878	7680	6500	43880	11265	10655	43880
1974		2022	8255	6950	47210	12120	11445	47210
1975		2022	8095	6840	45700	11895	11305	45700
1976		2022	8000	6685	44250	11770	11125	44250
1977		2022	7850	6505	42700	11570	10895	42700
1978		2022	7735	6410	41140	11400	10800	41140
1979		2022	7610	6195	39690	11230	10490	39690
1980		2022	7500	6045	38350	11065	10290	38350
1981		2022	7395	5805	37330	10920	10115	37330
1982		2022	7305	5755	36090	10800	9925	36090
1983		2022	7220	5690	35180	10685	9760	35180
1984		2022	7170	5605	34330	10620	9605	34330
1985		2022	7135	5545	33740	10560	9505	33740
1986		2022	7050	5435	32980	10440	9320	32980
1987		1969	6945	5315	32220	10275	9130	32220
1988		1926	6795	5195	31420	10065	8905	31420
1989		1870	6615	5035	30890	9820	8640	30390
1990		1807	6410	4870	29530	9505	8350	29530

(1) Based on production rate of 1 MMcfd for each 13 Bcf of new reserves.

(2) Actual growth for period October 1, 1959 to December 31, 1960 less portion shown in Tables A-1, A-2 and A-3.

TABLE A - 7

OIL AND GAS CONSERVATION BOARD

COMPARISON OF PRODUCTION FORECASTS FOR NATURAL GAS LIQUIDS FROM GAS RESERVES NOT YET DISCOVERED

(BARRELS PER DAY)

YEAR	PRODUCT	BOARD STUDY MINIMUM	BOARD STUDY MAXIMUM	FOOTHILLS PIPE LINES LTD. AND WESTALTA PRODUCTS PIPE LINE LTD.	BRITAMOIL PIPE LINE COMPANY LIMITED MINIMUM	BRITAMOIL PIPE LINE COMPANY LIMITED MAXIMUM	HYDROCARBONS PIPELINE LIMITED	PROVINCIAL PRODUCTS PIPELINES LIMITED
1965	PROPANE	1920	2790	10734	785	5785	3942	N.A.
	BUTANES	1680	2650	10960	690	4395	5502	N.A.
	PENTANES PLUS	10700	10700	36174	9875	9875	35447	24244
1970	PROPANE	5745	8995	23910	3760	20850	8565	N.A.
	BUTANES	4985	7940	24016	3230	15560	11953	N.A.
	PENTANES PLUS	32780	32780	70850	32200	32200	77014	36178

TABLE A - 8

OIL AND GAS CONSERVATION BOARD

RECOVERABLE RESERVES OF NATURAL GAS LIQUIDS

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		ESTABLISHED DISPOSABLE RESERVES OF NATURAL GAS	LIQUID RECOVERY FACTORS BBLS/MMCF (DISPOSABLE GAS)			RECOVERABLE LIQUIDS MILLIONS OF BARRELS			
FIELD, AREA OR PLANT	ZONE	BCF	PROPANE	BUTANES	PENTANES PLUS	PROPANE	BUTANES	PENTANES PLUS	TOTAL
ACHESON	LEDUC	29	75.0	40.0	20.0	2.2	1.1	0.6	3.9
ALEXANDER	BLAIRMORE	35			3.6			0.1	0.1
BEAVER CREEK	WABAMUN	80			10.0			0.8	0.8
BONNIE GLEN (1)	LEDUC	647	30.0	19.0	20.0	19.4	12.3	12.9	44.6
BURNT TIMBER	MISSISSIPPIAN	120			10.9			1.3	1.3
CALGARY	CROSSFIELD AND ELKTON	1330			19.1			25.4	25.4
CARBON	BLAIRMORE	110			4.2			0.5	0.5
CARSON CREEK	BEAVERHILL LAKE	70	10.4	11.6	74.0	0.7	0.8	5.2	6.7
CARSTAIRS	ELKTON	900			22.0			19.8	19.8
CESSFORD	BLAIRMORE AND COLORADO	1300			2.3			3.0	3.0
CHIGWELL	BLAIRMORE	60			7.4			0.4	0.4
COUNTESS	BLAIRMORE AND VIKING	104			1.8			0.2	0.2
CROSSFIELD	ELKTON	700			21.0			14.7	14.7
ENCHANT	BOW ISLAND, BLAIRMORE AND MISSISSIPPIAN	29			3.4			0.1	0.1
GILBY	BLAIRMORE, DETRITAL, MISSISSIPPIAN AND WABAMUN	395			11.5			4.6	4.6
GOLDEN SPIKE	BLAIRMORE AND DEVONIAN	94			50.0			4.7	4.7
HARMATTAN EAST	MISSISSIPPIAN	570			31.0			17.7	17.7
HARMATTAN ELKTON	MISSISSIPPIAN	1035			27.0			27.9	27.9
HOMEGLEN RIMBEY	LEDUC	765	4.2	6.7	31.0	3.2	5.1	23.7	32.0
HUSSAR	BLAIRMORE AND COLORADO	460			4.5			2.1	2.1
JUMPING POUND	MISSISSIPPIAN	450			10.0			4.5	4.5

TABLE A - 8 (CONT)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		ESTABLISHED DISPOSABLE RESERVES OF NATURAL GAS	LIQUID RECOVERY FACTORS BBLS/MMCF (DISPOSABLE GAS)			RECOVERABLE LIQUIDS MILLIONS OF BARRELS			
FIELD, AREA OR PLANT	ZONE	BCF	PROPANE	BUTANES	PENTANES PLUS	PROPANE	BUTANES	PENTANES PLUS	TOTAL
KAYBOB	NOTIKEWIN, CADOMIN AND BEAVERHILL LAKE	260	7.1	7.9	8.8	1.9	2.0	2.8	6.2
KESSLER	VIKING	70			13.7			1.0	1.0
LEDUC WOODBEND	LEDUC AND NISKU	386	24.0	18.0	9.0	9.3	6.9	3.5	19.7
LONE PINE CREEK	WABAMUN	100	4.8	6.9	18.0	0.5	0.7	1.3	2.5
LOOKOUT BUTTE	MISSISSIPPIAN	200	8.5	12.3	87.0	1.7	2.5	17.4	21.6
MINNEHIK BUCK LAKE	MISSISSIPPIAN	200			7.3			1.5	1.5
MORINVILLE	BLAIRMORE	85			10.7			0.9	0.9
NEVIS (2)	LEDUC AND NISKU	569	10.0	8.0	19.8	5.7	4.5	11.3	21.5
OKOTOKS	WABAMUN	140			5.2			0.7	0.7
OLDS	WABAMUN	120	5.4	6.5	23.4	0.6	0.8	2.8	4.2
PADDLE RIVER	JURASSIC AND MISSISSIPPIAN	28			8.0			0.2	0.2
PARKLAND	MISSISSIPPIAN	20			8.8			0.2	0.2
PEMBINA	CARDIUM	550	19.9	14.7	14.8	10.9	8.1	8.1	27.1
PEMBINA (LOBSTICK)	BLAIRMORE	100			12.0			1.2	1.2
PINCHER CREEK	MISSISSIPPIAN	1400	5.2	6.2	22.0	7.3	8.7	30.8	46.8
PREVO	MISSISSIPPIAN	40			8.1			0.3	0.3
PRINCESS	BOW ISLAND, BLAIRMORE, RUNDLE AND COLORADO	187			1.8			0.3	0.3
PROVOST	VIKING AND BLAIRMORE	515			1.5			0.8	0.8
REDWATER	LEDUC	45	105.0	96.0	35.0	4.7	4.3	1.6	10.6
SAMSON	BLAIRMORE	12			3.4			0.04	0.04
SARCEE	MISSISSIPPIAN	130			18.0			2.3	2.3
SIMONETTE	WABAMUN AND LEDUC	170	5.7	9.4	56.0	1.0	1.6	9.5	12.1
STOLBERG	MISSISSIPPIAN	70			2.4			0.2	0.2
SWAN HILLS (3)	BEAVERHILL LAKE	815	47.0	25.0	10.0	38.3	20.3	8.2	66.8

TABLE A - 8 (CONT)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		ESTABLISHED DISPOSABLE RESERVES OF NATURAL GAS	LIQUID RECOVERY FACTORS BBLS/MMCF (DISPOSABLE GAS)			RECOVERABLE LIQUIDS MILLIONS OF BARRELS			
FIELD, AREA OR PLANT	ZONE	BCF	PROPANE	BUTANES	PENTANES PLUS	PROPANE	BUTANES	PENTANES PLUS	TOTAL
SYLVAN LAKE	BLAIRMORE AND MISSISSIPPIAN	250	14.4	10.6	12.0	3.6	2.6	3.0	9.2
THREE HILLS CREEK	MISSISSIPPIAN	170			11.1			1.9	1.9
TURNER VALLEY	RUNDLE	290	6.1		18.9	1.7		5.5	7.2
WATERTON	MISSISSIPPIAN	750			35.0			26.2	26.2
WAYNE ROSEDALE	BLAIRMORE AND VIKING	215			5.3			1.1	1.1
WESTEROSE SOUTH	LEDUC	1300	6.6	8.8	22.0	8.6	11.4	28.6	48.6
WILDCAT HILLS	MISSISSIPPIAN	600			11.5			6.9	6.9
WIMBORNE	LEDUC	195	4.7	10.4	44.4	0.9	2.0	8.7	11.6
WINDFALL	LEDUC	400			120.0			48.0	48.0
WOOD RIVER	BLAIRMORE	30			8.6			0.3	0.3
WORSLEY	LEDUC	150			80.0			4.5	4.5
TOTAL						122.2	95.9	411.1	629.2
	ADDITIONAL RESERVES EXPECTED FROM THE REPROCESSING OF PIPELINE GAS								
						13.0	7.0	-	20.0
TOTAL						135.2	102.9	411.1	649.2
	ADDITIONAL RECOVERABLE RESERVES THAT MAY RESULT FROM INCREASED ECONOMIC INCENTIVE TO RECOVER PROPANE AND BUTANES								
INCREASED PRODUCTION (4)						6.0	4.2		10.2
CALGARY	CROSSFIELD AND ELKTON	1330	2.8	3.9		3.7	5.2		8.9
CARSTAIRS	ELKTON	900	6.0	5.9		5.4	5.3		10.7
CROSSFIELD	ELKTON	700	6.1	6.2		4.3	4.3		8.6
GILBY	BLAIRMORE, DETRITAL, MISSISSIPPIAN AND WABAMUN	895	2.5	2.6		1.0	1.0		2.0
MINNEHIK BUCK LAKE	MISSISSIPPIAN	200	4.9	6.9		1.0	1.4		2.4
WATERTON	MISSISSIPPIAN	750	4.8	4.6		3.6	3.5		7.1
WINDFALL	LEDUC	400	12.2	20.2		4.9	8.0		12.9
SUB-TOTAL						29.9	32.9		62.8
TOTAL						165.1	135.8	411.1	712.0

TABLE A - 8 (CONT)

(1) INCLUDES BONNIE GLEN, GLEN PARK AND WIZARD LAKE.

(2) INCLUDES NEVIS AND FENN-BIG VALLEY.

(3) INCLUDES CARSON CREEK NORTH, JUDY CREEK, JUDY CREEK WEST, SWAN HILLS AND VIRGINIA HILLS.

(4) PRESENTLY CONSIDERED BEYOND ECONOMIC REACH.

FIGURE A-1

ANTICIPATED FUTURE RESERVES
(APPRECIATION OF KNOWN RESERVES PLUS NEW DISCOVERIES)

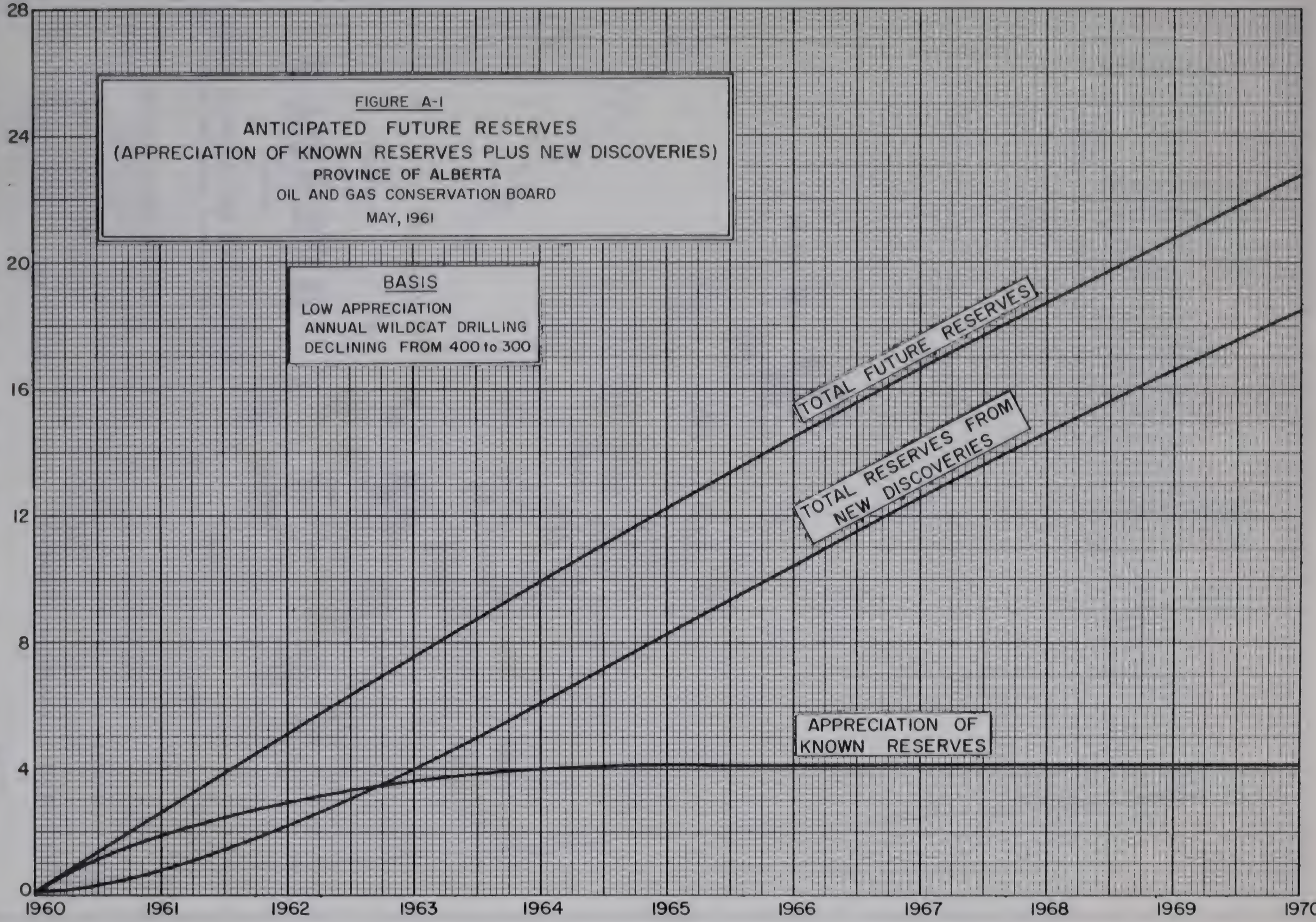
PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

BASIS

LOW APPRECIATION
ANNUAL WILDCAT DRILLING
DECLINING FROM 400 to 300



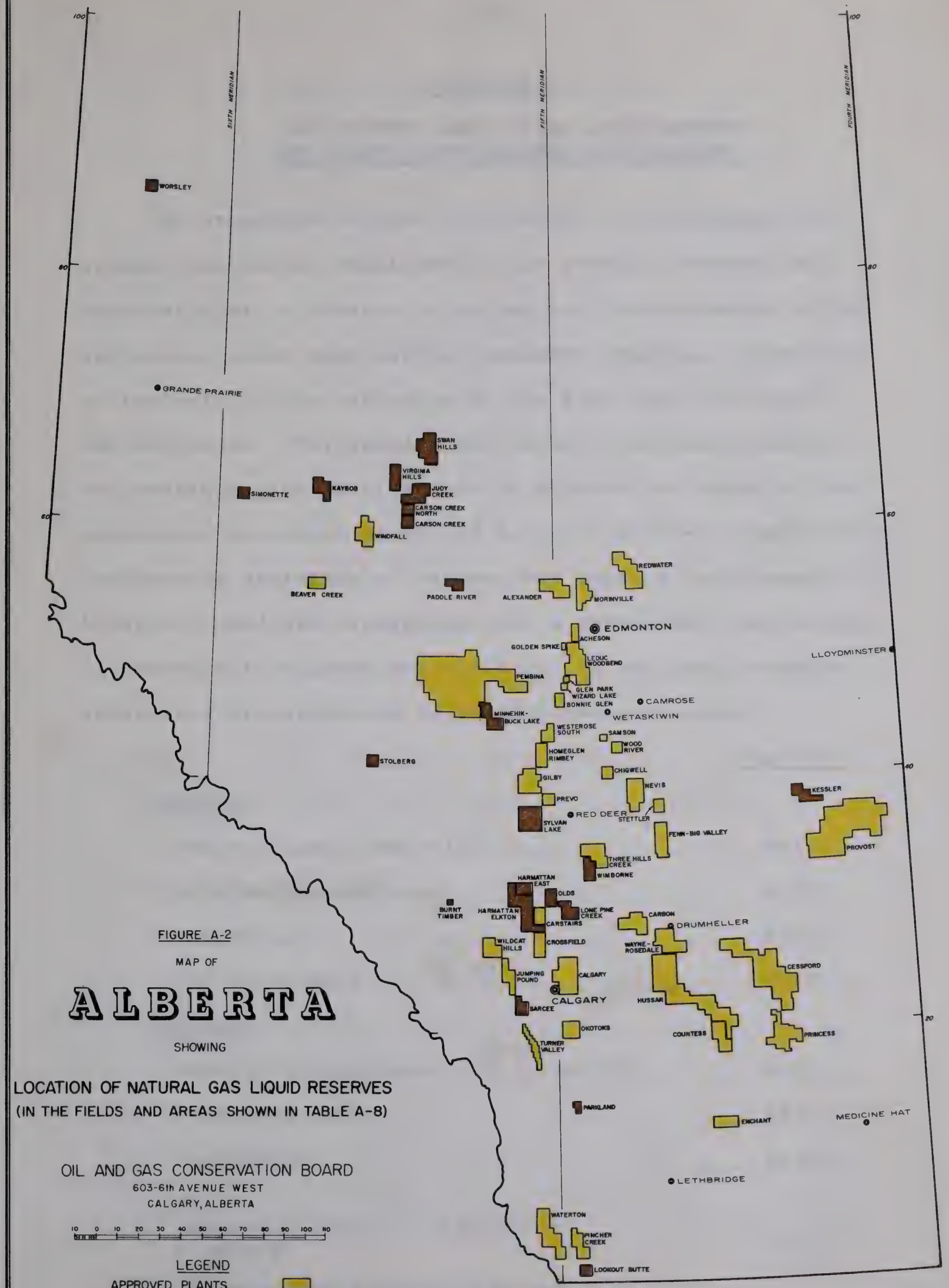


FIGURE A-2

MAP OF

ALBERTA

SHOWING

LOCATION OF NATURAL GAS LIQUID RESERVES

(IN THE FIELDS AND AREAS SHOWN IN TABLE A-8)

OIL AND GAS CONSERVATION BOARD

603-6th AVENUE WEST

CALGARY, ALBERTA

10 0 10 20 30 40 50 60 70 80 90 100 110

STATUTE MILES

LEGEND

APPROVED PLANTS_____

FUTURE PLANTS_____

MAY, 1961

APPENDIX B

THE PRESENT AND FUTURE REQUIREMENTS OF ALBERTA FOR NATURAL GAS LIQUIDS

The procedure adopted in Appendix B in reviewing the present and future requirements for propane, butanes and pentanes plus in Alberta is to set out the estimates of the applicants under each end-use category heading, followed by an analysis of the estimates by the Board and the Board's own estimates. The Board's estimates of propane, butanes and pentanes plus requirements in Alberta and those of the applicants are shown in Tables B-5, B-7 and B-9 respectively. The Board's estimates of propane and butanes requirements in Alberta by end-use categories over a thirty-year period are illustrated in Figures B-1 and B-2. In the text, end-use categories are presented in the following sequence:

	Page No.
PROPANE	
Domestic and Commercial	B-2
Internal Combustion	B-20
Industrial	B-26
Petrochemicals	B-29
BUTANES	
Domestic, Commercial and Industrial	B-33
Petrochemicals	B-34
Refineries	B-36
LPG Requirements for Miscible Flooding	B-40
CONDENSATE AND NATURAL GASOLINE (PENTANES PLUS)	B-43

PROPANE - DOMESTIC AND COMMERCIAL

The domestic and commercial demand category has been defined to include farm households, non-farm rural households and commercial establishments such as restaurants, hotels, motels, garages and similar types of establishments in the service trades situated beyond existing natural gas mains. Domestic and commercial establishments in urban areas, that is, centres of population in excess of 1,000 people, have been largely excluded from this category due to the fact that virtually all such centres are either presently supplied with natural gas or will have this service available in the relatively near future.

Britamoil Application - Stanford Study

The Stanford Research Institute in its marketing study prepared in support of the Britamoil application considered domestic and commercial demand for Western Canada as a whole and did not attempt to establish demand patterns by end-use for Alberta alone. The inclusion of refinery sources of liquefied petroleum gases in a number of their tables covering propane demand for Western Canada increased the difficulty in interpolating Alberta requirements in the domestic and commercial category for propane supplied by natural gas plants. However, interpretations by the Board would suggest that the Stanford Research Institute study estimated Alberta consumption in this category at 3,500

barrels per day in 1963, increasing to 6,600 barrels per day in 1970.

The ultimate market potential for propane in Western Canada, i.e., its share of total thermoenergy consumption by domestic and commercial users, was estimated by the Stanford Research Institute to be approximately equal to the percentage that the rural farm population represented of the total population. Based on experience in such states as Texas and California which, like Alberta, are producers of propane from natural gas, the Stanford Research Institute suggests that since the rural farm population in Western Canada is in excess of 20 per cent of the total population, the ultimate potential for propane consumption by this end-use would be equivalent to at least 20 per cent of all residential and commercial thermoenergy consumption. It places the ultimate market potential in Western Canada for domestic and commercial use at 30,000 barrels per day. Interpolating these estimates, it would appear that the Stanford Research Institute would set the comparable figure for Alberta at some 10,000 barrels per day of propane.

The Stanford Research Institute also points out that, on the basis of experience in the United States, saturation of the Western Canadian market would require fifteen to twenty years.

Foothills-Westalta Application - Harries' Study

Dr. Hu Harries in his study presented on behalf of the

Foothills-Westalta group, offered considerable data on both present day and expected levels of propane consumption by domestic and commercial users of propane in Alberta and adjacent markets. A market research study, entered as Exhibit 8 at the October, 1960 Foothills-Westalta hearing, was prepared by Dr. Harries and presented the Board with evidence on propane consumption patterns in farm areas of Alberta. This original study was extremely helpful to the Board in determining fuel consumption patterns in Alberta's farming community. The interveners at the hearing at which this report was presented raised questions as to the representative character of the sampling techniques employed by Dr. Harries and his staff in this survey.

The chief objection to accepting the conclusions of this study appeared to be associated with the fact that Dr. Harries drew his sample from farm households which account for only some 50 per cent of total domestic and commercial consumption of propane in the Province. Neither propane users in non-farm rural areas of the Province, nor commercial users of propane were covered by this sample, although estimates of consumption in non-farm rural areas were offered by the study.

On the basis of this study, Dr. Harries estimated that domestic and commercial use of propane in the Province for the year 1959 was some 24.4 million gallons (1,910 barrels per day). Under examination at the Foothills-Westalta hearing, Dr. Harries suggested that the actual level of

consumption could fall within a range of 10 per cent of his estimate.

Dr. Harries did not attempt to estimate the ultimate market potential for propane among domestic and commercial users. However, he did estimate that some 30 per cent of all farm and non-farm rural households used propane at the present time.

Dr. Harries further estimated that he would expect to see the propane market in the domestic and commercial category increase by 10 per cent per annum between 1961 and 1965 and at 5 per cent annually thereafter.

Hydrocarbons' Application - Purvin & Gertz Study

Mr. Otto Wetzel of Purvin & Gertz, Inc. and Mr. G. M. Miller of Canadian Hydrocarbons presented marketing data at the hearings on behalf of the Hydrocarbons' application.

Mr. Wetzel stated that the projection of the growth in demand in residential and commercial consumption of propane in the Purvin & Gertz study was based primarily on information from Canadian Hydrocarbons, the largest propane marketer in Western Canada. The experience of a company operating in the propane marketing field, which has made its own surveys of the potential market for this product, has been very useful to the Board in its consideration of the various estimates placed before it.

During the course of his testimony, Mr. Miller of Canadian Hydrocarbons stated that his company's forecasts

of propane requirements in Alberta in this end-use were based on a usage of 1,200 gallons per year by the average heating customer.

In its study, Purvin & Gertz estimated that consumption of propane by domestic and commercial users in Alberta would approximate 2,650 barrels per day in 1962 and increase to 5,070 barrels per day by 1971. This represents an average rate of growth of 7½ per cent annually. During his testimony before the Board, Mr. Miller indicated that this rate of growth would be, in the opinion of his company, a minimum rate of market development.

Purvin & Gertz made no reference to the ultimate potential available to propane in the domestic and commercial category in Alberta.

Provincial Products' Application - Fish Corporation Study

In its submission to the Board, Provincial Products indicated that its estimates of Alberta requirements for propane in the domestic and commercial category were based on information provided it by Canadian Hydrocarbons.

THE VIEWS OF THE BOARD

The problems faced by the applicants in preparing their estimates of the domestic and commercial propane market were:

1. the establishment of an accurate measure of present consumption levels in this category

to serve as a bench-mark upon which future rates of increase in demand could be projected,

2. the development of a measure of the ultimate potential market available to this fuel in Alberta, and

3. an estimate of the rate by which the consumption of propane would increase from present levels to approach market saturation.

1. Present Consumption Levels

One of the major sources of statistics on consumption of propane by end-use in Alberta is that published by the Board. However, the Board's statistics cover the movement of propane from gas plants to only a limited number of categories such as distributors, petrochemical plants, miscible flood projects and markets outside the Province. No attempt has been made by the Board to breakdown the propane handled by distributors into various end-use categories such as domestic and commercial, industrial and internal combustion.

To overcome the lack of statistics as to the final disposition of propane by Alberta distributors, the Board surveyed all distributors in the Province. The results of this survey indicated that 1959 propane consumption by domestic and commercial users in the Province was some 25.7 million gallons (2,015 barrels per day). This figure falls well within the range suggested by Dr. Harries and may be considered as a reasonable bench-mark for projections of

future propane demand in this category.

2. Market Potential

It has been noted that the Board's interpretation of the Stanford Research Institute's estimates would place the propane market potential in Alberta at some 10,000 barrels per day. This estimate by the Stanford Research Institute was largely based on experience in such states as Texas and California.

It is felt that a measure of market potential such as that used in the Stanford study does not take into account many variables that would produce significant differences in the market penetration obtainable by propane in the states of Texas and California as compared to that obtainable in Alberta. The type of comparison used by the Stanford study ignores the cost and availability of sources of energy competitive with propane such as electricity, gas, oil, wood and coal. It may be felt that coal and electricity, for example, are in a more favourable competitive position with respect to propane in Alberta than in Texas or California. But most importantly it did not appear that the Stanford study gave consideration to the relative levels of farm income in the three areas. Average farm income in Texas, for example, is over 25 per cent greater than in Alberta, while average farm income in California is some four times greater than in Alberta. It is felt that this factor alone will prevent propane from reaching the level of market saturation in

Alberta that it has attained in Texas and California.

A measure of market potential may be obtained by inference from the studies prepared by Dr. Harries on behalf of the Foothills-Westalta application. On page 63 of his supplemental marketing study, Dr. Harries concluded that some 30 per cent of rural farm and non-farm houses in Alberta were being supplied with propane. One hundred per cent saturation of this market, without allowing for an increase in average propane consumption, would represent an ultimate potential of slightly over 6,000 barrels per day.

There were a number of factors not discussed in detail in the submissions of the applicants, which perhaps can offer some further indication of the potential market available to propane among domestic and commercial users in the Province:

(a) Competitive Fuel Prices

One of the major factors that must be considered in estimating the inroads that propane can make into the space heating market is its competitive price position with respect to other fuels. The table below sets out a comparison of competitive fuel prices on a heating value basis at different levels of propane prices, without regard to efficiencies of related heating equipment.

	Competitive Fuel Prices on Heating Value Basis		
Cost of Propane per gal.	10,000 Btu Coal (Price per ton)	Furnace Fuel Oil (Price per bbl.)	1,000 Btu Natural Gas (Price per Mcf)
10¢	$18.20	$ 5.30	$ 0.90
15¢	$27.30	$ 7.90	$ 1.35
20¢	$36.40	$10.60	$ 1.80
25¢	$45.50	$13.20	$ 2.25

The above table indicates, on an approximate basis that if propane sold at 15 cents per gallon delivered, any price less than $27.30 per ton for coal, $7.90 per barrel for fuel oil or $1.35 per Mcf for natural gas, would make these fuels more competitive than propane. Natural gas prices in more remote centres may reach 75 cents to 80 cents per Mcf. It is clearly evident that propane selling at between 15 cents to 17 cents per gallon cannot compete with natural gas. Similarly, it may be seen from the above table that coal at $20.00 per ton is a considerably more economical fuel than propane at present day prices. However, the added convenience and cleanliness offered by propane compared to coal can counteract a substantial difference in relative prices between the two fuels. The advantages of convenience and cleanliness do not hold true to the same degree when propane and fuel oil are compared as heating fuels. At current prices of approximately $6.00 per barrel for fuel oil there is a substantial price advantage over propane.

It would appear that propane has, and will continue to have, a considerable degree of competition from fuel oil for domestic and commercial heating uses. However, an advantage will accrue to propane and partially offset its unfavourable price differential with respect to fuel oil in domestic and commercial applications

where the versatility of propane as a fuel for space heating, cooking, hot water heating and other uses can be utilized. It should also be noted that as the recovery of propane in natural gas processing plants grows in volume, a downward pressure on retail prices of propane will probably be evident.

(b) Defining the Domestic and Commercial Market

The domestic and commercial market available to propane may be divided into three main categories:

(i) the farm market,

(ii) the rural non-farm market,

(iii) the commercial market (stores, motels, etc.)

(i) The Farm Market

This market is represented by approximately 78,000 occupied farm dwellings in the Province. Past trends would indicate that farm mechanization and consolidation will probably continue in the future, bringing with it a further reduction in the number of occupied farm dwellings and, hence, a reduction in the total market available to propane distributors in this sector. (Occupied farm dwellings declined from 85,095 units to 80,708 units between the 1951 census and the 1956 census). Based on past experience, the annual rate by which farm dwellings are vacated

may vary from 0.5 per cent to 1 per cent of the total occupied dwellings. However, it should be pointed out that as time progresses a resistance to any substantial reduction in the number of occupied farm dwellings in the Province will develop.

Partially offsetting this trend to fewer potential customers will be a trend towards higher average consumption of propane per farm unit. In other words, it is felt that as the original cost of installing propane storage facilities and basic appliances for space heating, water heating and possibly cooking are met, the average farmer will tend to utilize his propane for additional uses such as clothes drying, brooder heating, weed killing and the heating of other buildings.

(ii) The Rural Non-farm Market

Unlike farm dwellings, the number of occupied dwellings in rural non-farm areas (including those on the outer fringe of urban centres with a population of 1,000 or greater) is expected to increase fractionally over the long-term. Between the 1951 census and the 1956 census, the number of occupied dwellings in the rural non-farm sector increased from 40,230 to 41,447 units.

Projecting past trends, it may be expected that the rate of increase in non-farm rural dwellings will be slightly over 0.5 per cent per annum. It should be pointed out that two factors of a statistical nature will tend to hold down the rate of growth in this area despite the general shift of population from farms to villages and towns;

(a) the extension of metropolitan boundaries to absorb fringe areas, and

(b) the redefinition of non-farm rural areas to urban areas once the population of a centre exceeds 1,000 persons.

(iii) The Commercial Market

No reliable measure has been obtained of the significance of the commercial market with respect to propane consumption. This market includes both commercial establishments in small communities and those along highways, such as motels, service stations and restaurants, which are not supplied with natural gas. The Board has estimated from information provided by propane distributors that commercial users in 1960 consumed approximately 20 per cent of total propane sales made in the domestic and commercial category.

(c) The Extent of the Domestic and Commercial Market

It would be difficult to assume that the 120,000

rural dwellings in the Province all offer a potential outlet for propane. Of the 78,000 farm dwellings, for example, some are already supplied with natural gas (the Liquefied Petroleum Gas Association estimates that 1,900 farm houses are capable of being supplied with natural gas at the present time), others will continue to use fuel oil as their principal heating fuel, still others are operated marginally and, therefore, would find it difficult to purchase or lease propane tanks and equipment and, still other farms, particularly in the northern part of the Province, may be considered to be in areas too remote to be supplied with propane economically or, as in the north-western area of the Province, would be supplied with propane from British Columbia.

Table B-1 offers a forecast of the number of Alberta farms expected to use propane in the decade years between 1960 and 1990. The data concerning usage of various types of principal heating fuels by Alberta farm dwellings in 1960 was estimated chiefly from the farm survey undertaken by Dr. Hu Harries. The actual number of farms using natural gas was obtained from the major natural gas distributing companies in the Province and an estimate of the number of farm gas wells from the Board's own records. This total is less than that which would be obtained

from Dr. Harries' study due to the fact that the selection of survey areas in his sample happened to include the township of Ardrossan which contains proportionately more farm users of natural gas than the Province as a whole. The number of farms using fuel oil, coal and wood was roughly confirmed by the statistics contained in the annual survey of household facilities and equipment published by the Dominion Bureau of Statistics.

Mr. Miller of Canadian Hydrocarbons stated that the average heating customer in the Province would consume approximately 1,200 gallons of propane per year. It is understood that the gallonage figures quoted by Mr. Miller represented quantities delivered at prevailing temperatures. The average quantity of propane consumed for heating uses measured at the standard temperature of 60 degrees Fahrenheit would be somewhat in excess of the figure quoted by Mr. Miller. The Board has estimated that in 1960, 4,600 farm homes in the Province used propane as a principal heating fuel and for domestic water heating purposes. These dwellings were estimated to have used an annual average of 1,600 gallons of propane (at 60 degrees Fahrenheit) for these uses in addition to an annual average of 300 gallons for other purposes such as cooking, auxiliary space heating and special farm

applications. It was further estimated that approximately 10,600 farms in the Province used an average of 300 gallons of propane for uses other than as a principal heating fuel in 1960.

In Table B-1 it is suggested that by 1990 some 27,850 farm dwellings of the total 70,000 dwellings expected to be occupied at that date will be using propane for their principal heating fuel and for heating water. An additional 12,150 farm dwellings are expected to be using propane for supplemental uses.

As shown in Table B-2, the Board has estimated that 10 per cent of the non-farm rural dwellings in the Province in 1960 used propane for primary space heating and the heating of water. Average propane consumption by these dwelling units has been increased to cover supplementary propane uses in other domestic dwellings not using propane for heating purposes. By 1990, it is estimated that only 13 per cent of the 50,000 non-farm rural dwellings will be using propane for heating purposes due, primarily, to the more serious competition offered by natural gas in this area.

Table B-3 shows total estimated propane consumption within the domestic and commercial category. It will be noted that an estimated 20 per cent of the

total propane consumption of 25,550,000 gallons in this category in 1960 was accounted for by commercial users. An additional 5 per cent of total propane consumption was estimated to be accounted for by miscellaneous cylinder users.

3. Rate of Market Development

Among the factors which were considered in determining the rate by which the propane market will develop are the trends expected in net farm income, the relative cost of propane to other fuels and the aggressiveness by which propane marketers exploit the market available to them now that greater supplies of the product will be available for local distribution.

The farm market offers propane its greatest area of potential growth, due essentially to the fact that natural gas is severely limited in the inroads it can make into this market. Propane can be expected to replace a substantial part of the heating fuel requirements now held by coal and wood. As discussed under the competitive fuel prices section of this report, fuel oil offers propane its major competition in this replacement market. However, as has been stated, the greater number of fuel applications that can be satisfied by propane on a typical farm will make it generally a more desirable fuel. Chiefly for these reasons, as shown in Table B-1, it is felt that the

number of farms using fuel oil will remain relatively constant over the period of the forecast, while propane will virtually take over the losses expected for coal and wood as principal heating fuels. Natural gas is expected to increase its share of the farm heating market as the extension of natural gas gathering and transmission lines makes this fuel available to a greater number of farms.

It is felt that the fifteen to twenty-year saturation estimate used in the Stanford Research Institute study will apply most specifically to the development of the farm market. On this basis, we would expect a marked increase in farm consumption of propane between 1960 and 1970, with a gradual tapering off after that date as saturation of the farm market is approached.

In the non-farm rural market, natural gas as a fuel source is a much more important factor. It is estimated that approximately 35 per cent of the dwellings in this area were supplied with natural gas in 1960. Future trends would indicate that the proportion of dwellings in this category served by natural gas will continue to increase. For example, such towns now included in the non-farm rural category as Blairmore, Coleman, Rocky Mountain House and Sundre will probably be supplied with natural gas in 1962. Other centres such as Coronation, Castor and Hardisty are also potential users of natural gas. Additionally, natural gas service is continually being extended to fringe areas

of urban centres as the dwellings in such areas reach adequate numbers to be economically supplied with natural gas. Fuel oil will also remain a serious competitor to propane in non-farm rural dwellings. However, as shown in Table B-2, it is expected that the proportion of homes in non-farm rural areas using propane will increase fairly steadily over the period of the forecast.

The commercial category offers some difficulty in determining the precise trend of market development. The continuing growth in the number of highway restaurants, service stations and motels in Alberta will provide a growing market for propane in future years. However, during the major part of the forecast period it is doubtful if the consumption of propane in the commercial category will grow as rapidly as total propane consumption. The reasoning behind this conclusion is that a depressing effect on propane consumption by commercial users will occur as commercial accounts are lost through the provision of natural gas to the urban and non-farm centres, such as those referred to in the preceding paragraph.

The consumption of propane by cylinder customers in summer resorts, trailer parks, construction camps and other similar areas can be expected to increase at a reasonably consistent rate over the period of the forecast.

Considering the factors affecting the demand in each of these sectors of the domestic and commercial category,

the Board expects that the rate of increase in propane consumption will average approximately 10 per cent per year to 1965. A declining rate of increase is expected to be evident from that time until saturation of the farm market is approached in the latter part of the forecast period.

Table B-4 gives a comparison of the development of the propane market in the domestic and commercial category in Alberta as forecast by four of the applicants. The Board's estimates for the 1961-72 period are also included in this table. The Board's forecast of propane requirements in this category over a thirty-year period is contained in Table B-5 and illustrated in Figure B-1.

PROPANE - INTERNAL COMBUSTION

Propane is being utilized as a motor fuel in Alberta in farm tractors, fork lift trucks, motor trucks and passenger buses.

Britamoil Application - Stanford Study

The Stanford Research Institute in its study points out that the internal combustion end-use for liquefied petroleum gases offers the greatest potential for future growth in Canada due in part to the virtual non-existence of this LPG application in the country at the present time.

The Stanford Research Institute states that the primary internal combustion application appears to be farm tractors and that in the United States LPG carburetion is used on over 8 per cent of all tractors. However, it does point out that it is unlikely that LPG marketers will capture any more than about 5 per cent of the Canadian tractor market by 1970.

Table XV of its report shows that 1960 consumption of propane for internal combustion use in Western Canada will average about 100 barrels per day and that 1963 consumption is expected to increase to 500 barrels per day, rising to 1,000 barrels per day in 1965 and 2,700 barrels per day in 1970.

As in other end-use analyses, the Stanford study does not differentiate between Alberta and Western Canada usage of propane by demand category. It is, therefore, difficult to determine what proportion of the forecasted Western Canadian demand for propane for internal combustion uses might be assigned to Alberta. From the most recent statistics available, approximately 35 per cent of the tractor population in Western Canada was located on Alberta farms. If such a factor as the proximity to sources of supply is taken into account, it may be considered that farm tractors in Alberta would consume a proportionately greater share of propane than tractors located in provinces with more limited supplies of propane. It is conceivable that over the long term

Alberta would account for something like 50 per cent of total tractor consumption of propane in Western Canada.

Foothills-Westalta Application - Harries' Study

Dr. Harries has estimated that sales of propane for carburetion purposes now approximate 1.5 million gallons per year and are expected to increase at a rate of 20 per cent per annum. It is also interesting to note that in his survey of 527 farm homes in Alberta, Dr. Harries discovered only four users of propane-fueled tractors and little indication of interest among those interviewed in future plans to purchase such tractors.

Hydrocarbons Application - Purvin & Gertz Study

In its study, Purvin & Gertz indicated that it would not expect to see a spectacular growth in demand for propane for internal combustion purposes, although some further application can be anticipated in the case of new farm machinery.

Unfortunately, Purvin & Gertz did not distinguish between industrial and internal combustion uses in the quantity estimates shown in its tables. They show a demand of 470 barrels per day for these two end-uses in 1962, increasing to 1,150 barrels per day in 1971.

THE VIEWS OF THE BOARD

It is difficult to obtain a clear indication of actual consumption of propane for internal combustion uses

at the present time.

The Stanford Research Institute estimated that 1960 propane consumption in the internal combustion category for Western Canada would be at the rate of 100 barrels per day or 1,277,500 gallons for the year. If it is assumed that 75 per cent of this consumption occurred in Alberta, the figure for the Province would be about 960,000 gallons.

Dr. Harries estimated that consumption in this category in 1959 was some 1,500,000 gallons.

Based on information provided by the Fuel Oil Tax Branch of the Department of the Provincial Secretary on taxable sales of propane for carburetion purposes, data supplied by the City of Edmonton, the Board's survey of propane distributors and the information provided by the applicants, it would appear that the consumption of propane in Alberta for carburetion purposes in 1959 was slightly over 1,000,000 gallons.

The Board consulted the Alberta Research Council with respect to the potential demand for propane for internal combustion uses in the Province. The Research Council believes that future trends would appear to be favourable for a relatively rapid rate of growth in usage of propane for internal combustion purposes, although actual volumes of propane going to this end-use would not be substantial for a number of years. The greatest potential area of growth in this sector would appear to be in the industrial

fork lift truck and farm tractor fields. Any major increase in propane fuel consumption by motor trucks, passenger cars or passenger buses would appear to be restricted at this stage in the development of the market by the limited availability in Canada of suitable engines designed specifically for the use of propane.

A limiting factor also appears with respect to the possible increase in the use of propane-fueled farm tractors in Alberta. In his survey of farm occupants in Alberta, Dr. Harries came to the view that a deterrent to a substantial growth in propane consumption in this field is the cost of converting present tractors to the use of propane. From his survey, Dr. Harries concluded that the most likely way of increasing propane use as tractor fuel would be through the purchase of new tractors in Alberta with propane engines installed at the factory. This conclusion was confirmed by interviews with farm equipment distributors by the Board's staff.

There can be no doubt that the sale of a substantial number of propane-burning tractors in the Province will require a considerable amount of promotion work on the part of propane distributors and farm equipment agencies. Alberta propane distributors are provided an incentive to develop a propane market in the farm tractor field since the seasonal peak in demand in this sector is reached in the spring and early summer months when the important domestic and

commercial market is near its seasonal low.

Propane distributors in Alberta have estimated that the average propane-fueled farm tractor consumes approximately 1,300 gallons of propane annually. If propane-fueled tractors represented 8 per cent of farm tractors in Alberta, they would consume approximately 10,000,000 gallons of propane each year or slightly under 800 barrels per day for this end-use alone. This would make it evident that a fairly large market could develop for propane in this end-use category.

Farm equipment distributors suggest that the life of a farm tractor varies from fifteen to twenty years, which would indicate that a substantial number of the tractors purchased in the early post-war years will be due for replacement from the mid-1960's onward. During 1959, some 59 per cent of new tractors purchased in Alberta were equipped with diesel engines. A farm equipment distributor has suggested that as more Alberta farms install propane equipment, there is a possibility that the current diesel tractor sales cycle could be superseded by an increase in the sale of propane tractors.

It is conceivable that if sales of propane tractors were actively promoted, their sales could represent some 10 per cent of the four to five thousand farm tractors which are sold annually in the Province. On this basis, and including the growth in demand for propane for fork

lift trucks and other vehicles, the Board estimates that a growth rate of approximately 25 per cent annually in propane consumption in this field will occur to 1965, 15 per cent to the early 1970's and a decreasing rate of growth beyond that date.

The Board's thirty-year forecast of Alberta and fringe area requirements for propane for internal combustion uses is given in Table B-5 and illustrated in Figure B-1.

PROPANE - INDUSTRIAL

Industrial uses for propane, which exclude the petrochemical field, may be categorized in four main fields,

(a) as a heat source for drying such products as lumber, gravel and grain,

(b) as a refrigerant in certain uses such as gas processing plants and highway refrigerator trucks,

(c) as a special fuel for industries located in remote areas, and

(d) as a load-balancing agent for industries using natural gas on an interruptible basis.

Fuel used by fork lift trucks and other industrial vehicles has been included under the internal combustion category.

Britamoil Application - Stanford Study

The Stanford Research Institute has estimated that the

industrial uses of propane in Western Canada will equal 500 barrels per day or 6,387,500 gallons in 1960. The output of manufacturing industries in Alberta is approximately 30 per cent of total Western Canadian output. On such a basis and including consideration of proximity to source of supply, Alberta's share of the figure attributed to all Western Canada in the industrial sector might be some 250 barrels per day.

The Stanford Research Institute points out that, based on experience in the United States, the industrial use of LPG is generally less than 1 per cent of total industrial fuel requirements in a given area.

Westalta Application - Harries' Study

Dr. Harries presented evidence to the effect that the industrial uses of propane would amount to some 130 barrels per day in 1962.

Hydrocarbons' Application - Purvin & Gertz Study

Purvin & Gertz has indicated that it would expect industrial requirements for propane to be nominal, representing about 10 per cent of residential and commercial demand.

Ten per cent of 1961 residential and commercial consumption would represent an industrial demand of something in the order of 230 barrels per day.

THE VIEWS OF THE BOARD

Exact measures of current consumption of propane by industrial users were unobtainable from either the submissions of the applicants or the surveys conducted by the Board. However, the data which were obtainable would indicate that industrial demand for propane did not exceed 50 barrels per day in the Province in 1959.

It would appear that an estimate based on the experience in certain areas of the United States, as reported by the Stanford Research Institute, wherein LPG consumption by industries is estimated at under 1 per cent of total industry fuel requirements, would be difficult to justify in Alberta. One per cent of industrial fuel consumption in the Province would represent some 600 barrels per day of LPG. It should also be noted that it is most unlikely that the major natural gas distributors in Alberta will require LPG in the near future for peak-load shaving. However, future requirements for industrial use could grow significantly as greater quantities of propane are made available and its usefulness as a fuel source is fully realized.

The Board has estimated that propane requirements in the industrial category will increase approximately 15 per cent annually to 1970 and at a somewhat lower rate of increase beyond that date.

A thirty-year forecast of Alberta and fringe area propane requirements for industrial purposes as prepared by the Board is given in Table B-5 and illustrated in Figure B-1.

PROPANE - PETROCHEMICALS

Canadian Chemical is the only petrochemical plant in Alberta at the present time that utilizes propane and butanes as petrochemical feedstocks. As a result, all applicants based their estimates of LPG requirements for petrochemical uses on information provided by Canadian Chemical.

At the Foothills-Westalta hearing of October 4th, 1960, Mr. Wurzbach of Canadian Chemical advised the Board that the earlier information provided to interested parties as to the forecast quantities of propane required by his company would have to be revised upwards. The revised information supplied by Canadian Chemical indicated that the consumption of propane in their plant would increase from an average of 2,000 barrels per day in the latter part of 1960 to 3,200 barrels per day by 1965.

Under examination, Mr. Wurzbach stated that currently approximately 35 per cent of their propane was obtained from sources other than gas processing plants, i.e. refinery off-gases. It was also indicated by Mr. Wurzbach that the proportion of propane and propylene obtained from refineries as compared to their total propane requirements would decline.

It is not believed that the establishment of alkylation facilities in the Edmonton area will be a factor in reducing the volume of propylene available to Canadian Chemical since present economics do not appear favourable for the alkylation of propylene. The recent addition of a third refinery source

of light ends and the anticipated long term increase in refinery through-put in the Edmonton area would also seem favourable for increased supplies of propane and propylene being made available. However, the absolute increase in propane requirements of Canadian Chemical are indicated to be at such a level as to make this company increasingly dependent on gas plant sources of propane.

Under examination by the Board, Mr. Wurzbach indicated that he would expect to see the rate of growth forecast to occur between 1960 and 1965 in the petrochemical industry in Alberta continue on beyond 1965. If it is assumed that the supply of refinery propane and propylene to petrochemical plants will decline from the present level of 35 per cent of total feedstock requirements to approximately 30 per cent by 1965, field propane requirements would increase from approximately 1,300 barrels per day in 1961 to 2,240 barrels per day by 1965.

Canadian Chemical forecasts that its feedstock requirements will increase by approximately 8.0 per cent per annum between 1961 and 1965. The Board assumes that the change-over in feedstocks from butane to propane will be completed at the Canadian Chemical plant before 1965. The Board also assumes that Canadian Chemical will continue to receive 30 per cent of its propane requirements from refineries in the Edmonton area beyond 1965.

None of the applicants made allowance for the establishment of new petrochemical plants in Alberta based on the

use of field propane as a feedstock. The Board finds it difficult at this stage to judge the type of product that would lead to the establishment of additional large scale petrochemical plants in Alberta utilizing liquefied petroleum gases. The costs involved in transporting intermediate or finished chemicals to major consuming areas limit the types of petrochemicals that can be economically produced in Alberta to those having a high price to weight ratio and, ideally, those which consume a substantial quantity of raw materials in relation to a unit of output and require a great deal of energy to bring about the necessary chemical changes.

It is recognized that, in addition to the availability of low cost fuel and raw materials, an important factor in bringing the large Canadian Chemical plant to Alberta was the availability of chemical grade pulp from an associate company in British Columbia. Canadian Industries Limited, on the other hand, based its decision to locate in Alberta on the availability of substantial quantities of low cost fuel and raw materials which were required in their particular process for the production of polyethylene.

The Board feels that the factors considered by C.I.L. before establishing in Alberta perhaps offer the best indication of the direction that future petrochemical developments in the Province might take; that is, along the lines where large quantities of both relatively cheap

raw materials and cheap fuel are a basic requirement in a particular petrochemical process to produce chemicals having a high unit value. There are a number of processes currently in use and others under development for the production of such products as polypropylene and ethylene-propylene co-polymers for which the above conditions are satisfied. The Board feels that such processes will form the basis for the expansion of the range of petrochemicals manufactured in Alberta. The Board also recognizes that further growth on a smaller scale will also occur in the petrochemical field based on the production of chemicals for the oil, gas and agricultural industries.

Reflecting the testimony of Mr. Wurzbach of Canadian Chemical, it is felt that an 8 per cent rate of growth in field propane requirements for the petrochemical industry in Alberta would be reasonable for existing plants.

Although an 8 per cent rate of growth may be considered fairly substantial (it is equal to the maximum estimate of the rate of growth of the Canadian chemical industry as a whole as projected by the Royal Commission on Canada's Economic Prospects), it is felt that some allowance must be made for the possible development of other major propane consumers in the petrochemical field in the Province, possibly between 1963 and 1968. To cover this possibility, the quantities of propane which it is forecast will be consumed by Canadian Chemical in 1964 and 1965 have been

increased by 100 barrels per day in each year and the rate of growth between 1965 and 1968 has been increased to 10 per cent per annum. An 8 per cent rate of growth has been projected between 1968 and 1974, falling off to 5 per cent per year thereafter.

The Board's thirty-year forecast of propane requirements by petrochemical plants in Alberta is shown in Table B-5 and Figure B-1.

PROPANE - FRINGE AREA REQUIREMENTS

Propane requirements in areas adjacent to Alberta are discussed in detail in Appendix C of this report.

Total propane requirements in Alberta and fringe markets over a thirty-year period, as estimated by the Board, are presented in Table B-6 of this Appendix.

BUTANES - DOMESTIC, COMMERCIAL AND INDUSTRIAL

Generally, the applicants did not consider that domestic, commercial and industrial consumers in Alberta would require significant quantities of butanes. The Stanford Research Institute estimated that total requirements by these end-uses in Western Canada would amount to 600 barrels per day in 1960, rising to 1,800 barrels per day by 1970.

In the past, minor quantities of butanes have been blended in with propane for sale to domestic and commercial users during summer months. The Board expects that this

end-use for butanes will tend to increase in the future in direct relationship to the increase in demand for propane for domestic and commercial applications.

Similar to butanes use by domestic and commercial consumers, the demand for butanes by industrial users is very limited in Alberta. Only nominal quantities of butanes have been allotted to this end-use by the Board over the period of the forecast.

Forecast butanes requirements in these categories as projected by the Board are shown in Table B-7 and Figure B-2.

BUTANES - PETROCHEMICALS

As in the case of propane, all applicants based their estimates of butanes utilization for petrochemical purposes on information supplied by Canadian Chemical, the only user of butanes as a petrochemical feedstock in Alberta at the present time.

The substantial switch-over in feedstocks from butanes to propane indicated by Mr. Wurzbach of Canadian Chemical will result in a very limited use of butanes by this plant in the future. Consumption of field butanes by Canadian Chemical in 1959 was at the rate of approximately 1,100 barrels per day. By 1965, Canadian Chemical has estimated it will be consuming a total of 300 barrels per day of butanes received from both gas plants and refineries.

In 1960, approximately 30 per cent of Canadian

Chemical's requirements of butanes were met by refinery off-gases. As the total quantities of butanes required by this plant decline, it is conceivable that a proportionately greater share will be obtainable from refineries. The Board expects that by 1965 a minimum of 35 per cent of the butanes requirement will be received from refineries. Under such circumstances, Canadian Chemical will require about 195 barrels per day of butanes from gas processing plants in 1965.

Both the Stanford and Purvin & Gertz studies indicate that there is little likelihood of the development of additional petrochemical plants which will be major users of butanes in Alberta within the next ten years. Dr. Harries, however, has made provision in his estimates for butanes demand of over 2,000 barrels per day by 1965 for a possible butadiene plant.

It should be noted that since Polymer Corporation Limited originally considered building a butadiene plant in Alberta, additional capacity has been made available at Sarnia. Should Polymer require additional butadiene, there is a strong possibility that more of this product could be made available in the Sarnia area. On balance, it seems unlikely that Polymer will construct a plant in Alberta in the near future.

At the present time, there are no firm plans for the establishment in Alberta of any other petrochemical plants based on the utilization of butanes. However, as pointed

out by Mr. Wurzbach during the course of the last Westalta hearing, the petrochemical industry is a dynamic one and some consideration of future developments in this field in Alberta must not be overlooked. For these reasons an allotment of 500 barrels per day has been included with the estimates of Canadian Chemical's requirements for 1965 and an additional 100 barrels per day has been added each year between 1965 and 1970 to cover the possibility of the construction of a second petrochemical plant in Alberta using butanes some time after 1964. Since the base on which future growth is to be projected is relatively small, the rate of growth of butanes utilization in the petrochemical field will, as forecast by the Board, grow at 10 per cent per year between 1965 and 1970, 8 per cent between 1970 and 1975 and 5 per cent thereafter.

Table B-7 and Figure B-2 illustrate the Board's forecast of butanes use by petrochemical plants in Alberta in the thirty years after 1961.

BUTANES - REFINERIES

Butanes are used as gasoline blending components primarily during winter months when atmospheric temperatures are low enough to prevent excess vapourization of the butanes blended into the gasoline. Iso-butane is used chiefly by refineries as an alkylation feedstock to produce alkylate gasoline which, in turn, is one of the components blended

with straight run gasoline to produce high octane gasoline.

Requirements for butane and iso-butane by Alberta refineries have exceeded their internal production of light ends in recent years. As a consequence, a growing demand within certain refineries in Alberta has developed for both butane and iso-butane from gas processing plants.

Britamoil Application - Stanford Study

The Stanford Research Institute predicts that the net deficit of refineries in Western Canada for butanes will increase from approximately 1,000 barrels per day in 1960 to 5,100 barrels per day in 1970. No estimates were made available by the study covering deficits of Alberta refineries alone for butanes.

Foothills-Westalta Application - Harries' Study

Dr. Harries has stated in his marketing study that Alberta refineries will require approximately 1,500 barrels per day of butanes for alkylation purposes by 1962.

Hydrocarbons Application - Purvin & Gertz Study

Purvin & Gertz estimates that demand for butane and iso-butane by Alberta refineries in 1962 will approximate 690 barrels per day and increase to 1,055 barrels per day by 1971, an average rate of increase of less than 5 per cent annually.

THE VIEWS OF THE BOARD

At the present time, there are two alkylation units operated by refineries in Alberta, one located in Edmonton and the other in Calgary. The original unit was constructed in the Calgary area to produce aviation gasoline. It is expected that the demand for aviation gasoline will continue to decline in Alberta as the use of jet and turbo-prop aircraft increases. However, it is expected that the average octane rating of premium and regular grade motor gasolines taken together will increase and bring with it a continuing high level of demand for higher octane gasoline. Under these conditions, it can be anticipated that the demand for field iso-butane as an alkylate feedstock may also increase. It is also expected that the demand for butanes for gasoline blending will increase in Alberta in proportion to the growth in demand for gasoline. The Stanford study supports this view.

Utilization of field butanes in Alberta has increased substantially in 1960 over 1959 demand levels. In 1959, refineries in Alberta used an average of 432 barrels per day of field butanes. During 1960 consumption of normal butane and iso-butane by the refineries has averaged approximately 975 barrels per day. It is expected that average consumption in 1961 may approach 1,200 barrels per day.

In the immediate future, the Board expects that the switch-over from butanes to propane feedstocks at Canadian

Chemical will increase the internal supply of butanes at the refinery in Edmonton in which the newer alkylation unit is located. However, this alkylation unit has not been operating at its full capacity as yet and, as its rate of operation increases, it is likely that greater quantities of field products will be used. It is also possible that other refiners in Alberta who own supplies of field butanes will consider the addition of alkylation units to their refineries as a means of improving their return on butanes produced by gas plants they own or in which they have an interest. Newer refineries which are designed to use condensate, on the other hand, will probably obtain the type of gasoline required to meet market demands by the installation of catalytic reforming equipment.

On the whole, the Board expects that the demand for butanes for gasoline alkylate and for gasoline blending will continue to increase moderately over the long term in Alberta. It should be noted that long term forecasts of this nature cannot anticipate changes in refinery technology which could conceivably alter the demand for particular feedstocks.

The Board estimates that the demand for field butanes by Alberta refineries will reach something over 1,600 barrels per day by 1964 and increase after that date at an average rate of 4 per cent per annum.

The Board's thirty-year forecast of demand for butanes by Alberta refineries is given in Table B-7 and shown in Figure B-2.

LPG REQUIREMENTS FOR MISCIBLE FLOODING IN ALBERTA

Foothills-Westalta Application - Harries' Study

The submission prepared for the Foothills-Westalta group by Dr. Harries made no specific reference to the use of butanes for miscible flooding, but did forecast propane requirements of 800 barrels per day for miscible flooding purposes by 1962, growing thereafter at an annual rate of 5 per cent.

Britamoil Application - Stanford Study

The submission prepared by the Stanford Research Institute for Britamoil included estimates based on discussions with Western Canadian oil producers, which project the Western Canada miscible flood demand from 1,000 barrels of propane and 1,000 barrels of butanes per day in 1960 to 1,800 barrels of propane and 1,700 barrels of butanes per day in 1970. The three methods of miscible phase displacement, i.e. injecting dry gas at high pressure, cycling LPG rich gas and the LPG "slug" process, were mentioned with the comment that the last named process had drawn the greatest interest.

Hydrocarbons' Application - Purvin & Gertz Study

The submission prepared by Purvin & Gertz for

Hydrocarbons estimated that the propane demand for miscible flood in Alberta would start at 1,200 barrels per day in 1962 and increase annually by 100 barrels per day to 2,100 barrels per day by 1971. The butane requirements were estimated to be in the same amounts.

THE VIEWS OF THE BOARD

The Board has estimated the volumes of LPG which it believes will be used for miscible flooding in that portion of Alberta's proven oil reserves amenable to miscible flooding. Since the Board has given primary consideration to the trend over a two-year period in discoveries of new gas reserves in the production portion of this report, the Board considers it is consistent to estimate LPG requirements for the miscible flooding of future reserves on the same two-year discovery trend.

Current economics indicate that specific light gravity crude oil reservoirs may be amenable to the "miscible slug process" under special conditions. However, reservoirs with relatively high pressures and containing more volatile crudes are thought to show more favourable economics with the use of the "condensing gas drive" miscible flood process than with the use of the miscible slug process.

The proven reserves assumed to be amenable to a miscible flood recovery process were considered to be located in the Pembina Cardium Pool and the Swan Hills-Kaybob Beaverhill Lake complex. It was assumed that miscible flooding by

the condensing gas drive process would be more attractive than the LPG slug process due to the generally high reservoir pressures in the pools in the Swan Hills-Kaybob area. The Board estimates that one-third of the reserves in the area could be pressure maintained under miscible drive using such separator gases as may be gathered from the entire Swan Hills area. While such a miscible process requires a considerably greater total LPG content than does the slug process, the net effect is to extend the time of LPG injection while conserving solution gas and avoiding the cost of an LPG separation plant.

In its LPG production estimates, the Board has assumed certain levels of propane and butanes recovery from the Swan Hills-Kaybob area. The volumes presented in Table B-8 from 1962 on as LPG required to flood established reserves, include these same quantities of propane and butanes on the assumption that the quantities of LPG which would have been recovered in the Swan Hills-Kaybob area would be lost to the market if this miscible flood project is undertaken. The figures for 1961 and 1962 include LPG's authorized for injection into Board approved LPG flood schemes in the Pembina Cardium Pool. No specific provision for any additional miscible flood schemes in the Pembina Cardium Pool has been made by the Board beyond 1962.

If the assumptions made by the Board with respect to the Swan Hills-Kaybob area are not fully realized, the Board feels that the quantities of propane and butanes allocated for miscible flooding purposes in this area will provide a reserve for the possible continuation of miscible flooding in the Pembina Field or in other pools in the Province.

LPG requirements as estimated by the Board for miscible flooding of both discovered and undiscovered oil reserves are shown in Table B-8 over a thirty-year period. Propane and butanes requirements for this purpose are also shown individually in Tables B-5 and B-7 and Figures B-1 and B-2.

CONDENSATE AND NATURAL GASOLINE (PENTANES PLUS)

Each of the applicants presented views concerning the future requirements in Alberta for condensate and natural gasoline based on the projected demand of Alberta refineries for these gas by-products. None of the applicants anticipated the development of a demand for pentanes plus by petrochemical plants in Alberta during the ten-year forecast periods which they generally employed. All stressed the fact that the demand for gasoline and light distillates is increasing in Alberta in such a manner as to make condensate an increasingly attractive charge stock for local refineries due to its higher yield of gasoline compared to that obtainable from typical Alberta crude oils.

Britamoil Application - Stanford Study

The Stanford Research Institute points out that there is a substantial interest in condensate by refineries and that Canadian interest is centred primarily in the Prairie Provinces. They state that the growing interest in condensate in the Prairie Provinces is due to rapidly increasing market requirements for gasoline and jet fuel and the fact that by using condensate, refineries in this area can make the necessary yield adjustments with relatively low capital investment.

Stanford states further that the use of condensate in refineries, having as it does such a different yield pattern from most of the crudes presently in use, would lower the operating rate on some of the existing process units and thereby lengthen the payout time on these facilities. Lower prices for condensate would be required to compensate for the lower operating rate of some process units.

On the assumption that 60 per cent or more of the future growth in throughput of Prairie refineries will be based on the use of condensate, the demand for condensate and natural gasoline in Alberta is forecast as increasing from 6,000 barrels per day in 1960 to 20,000 barrels per day in 1965 and to 30,000 barrels per day in 1970.

Westalta Application - Harries' Study

In his study, Dr. Harries projected a condensate use

in Alberta growing from 14,500 barrels per day in 1962 to 22,000 barrels per day in 1966 and a maximum Alberta condensate use growing from 18,000 barrels per day in 1962 to 43,000 barrels per day in 1966. The maximum figures were indicated as being rough estimates based on very material changes in existing plants.

Hydrocarbons' Application - Purvin & Gertz Study

The Purvin & Gertz study also states that markets in the Prairie Provinces, particularly Alberta, are becoming largely gasoline-dominated markets and the residual fuel oil market is disappearing. With a diminishing market for fuel oil, Purvin & Gertz states that the Prairie refineries must produce an increasing percentage of gasoline per barrel of charge. The use of condensate would favour this increased gasoline yield.

Purvin & Gertz indicates that in the light of existing refinery facilities and market requirements in Alberta, 15 per cent of refinery crude runs in 1960 could have been met by condensate. With condensate available in quantity, Purvin & Gertz suggests that Alberta refiners could program further expansion so that condensate could represent 50 per cent of future increases in crude runs. Such expansion, it is suggested, could be based largely on the installation of additional distillation and catalytic reforming capacity directed to the use of condensate.

Purvin & Gertz projects the refinery demand for condensate at 14,100 barrels per day in 1962, increasing to 30,700 barrels per day in 1971. It states that these figures do not represent the maximum amount of condensate which could be used within the Province.

Provincial Products' Application - Fish Corporation Study

Forecasts of condensate requirements in Alberta in this study were stated as having been based on information obtained from Alberta refiners. On the basis of these reports, condensate usage by Alberta refineries is forecasted to increase from 15,900 barrels per day in 1961 to 27,100 barrels per day in 1970.

THE VIEWS OF THE BOARD

Following the close of the Foothills-Westalta hearings, the Board asked the major oil refiners in Alberta for their estimates of the volumes of condensate and natural gasoline they would expect to run in the ten-year period to 1971 and in the year 1981. The full co-operation of the refiners in providing forecasts of their pentanes plus requirements was very helpful to the Board in considering the estimates submitted by the applicants and those prepared by the Board's own staff.

In reviewing the minimum and maximum estimates provided by the refiners and the estimates of the applicants, the Board recognized that the overall demand for pentanes plus

in Alberta will depend to a large extent upon the demand for different types of petroleum products in Alberta and its peripheral marketing area. A number of applicants gave the opinion that Alberta is becoming a gasoline-dominated market due to the continuing decline in demand for residual oils. It does appear likely that natural gas will continue to increase its share of provincial energy requirements, and partly at the expense of fuel oils. However, the Board feels that the major effect of the loss of residual oil markets through such factors as competition from natural gas and the dieselization of railroads has already been felt. The table below illustrates the major shift in demand which has occurred between classes of petroleum products in Alberta and its fringe markets since 1950.

Percentage Demand for Various Classes of Refined Petroleum Products in Alberta and Fringe Markets - 1950, 1955 and 1960

Year	Gasolines	Middle Distillates	Heavy Fuel Oils	Total for Selected Classes
1950	54.0	17.0	29.0	100.0
1955	56.0	26.0	18.0	100.0
1960	57.0	34.0	9.0	100.0

Source: Refined Petroleum Products, Dominion Bureau of Statistics, Ottawa.

The Board does not expect that the future rate of growth in the demand for gasoline in Alberta will equal the rates of increase which occurred in the late 1940's and early 1950's. The number of persons per motor vehicle in Alberta is rapidly

approaching the numbers considered to represent a saturated market for a given population. A greater proportion of future sales of motor vehicles will depend, as a result, on the growth of the population in Alberta and peripheral areas rather than the unsatisfied demand of the existing population. This factor will tend to limit the rate of increase in sales of motor fuel despite an expected increase in the number of miles travelled by an average vehicle. Another significant factor which will affect sales of gasolines in Alberta occurred as a result of the conversion of aircraft of the major air lines in Alberta from piston to turbine powered craft. A very marked decline in aviation gasoline requirements took place in late 1960 and early 1961 because of this development. It is doubtful if increased demand for aviation gasoline by other users will reverse the present downward trend in sales until the mid-1960's. The Board also expects that the rate of growth in demand for motor gasoline will be adversely affected by the continuing shift from gasoline to diesel-fueled tractors on Alberta farms.

There is a considerable amount of evidence available today to indicate that the major area of growth in the demand for petroleum products in Alberta and fringe markets will be in the middle distillates category. Diesel fuel oil for farm tractors, railroads, highway hauling and other industrial uses is expected to increase in demand steadily.

Jet fuel and turbo-prop fuel requirements for aircraft will probably show substantial increases during the early part of the forecast period. Requirements for No. 2 and 3 fuel oil are not expected to decline significantly from present levels and may conceivably show increases during a part of the forecast period.

Of the heavier petroleum products, asphalt and lubricating oils and greases are expected to show fairly constant rates of growth.

Under such market requirements, the different yields of refined products which may be obtained from various qualities of pentanes plus are important considerations in determining the volumes which may be used in Alberta refineries. Since natural gasoline produced from casing-head gas is virtually all in the gasoline boiling range, little flexibility in yields is offered a refiner when this product is used. A refiner using condensate with an API gravity between 50 and 60 degrees, on the other hand, has greater flexibility as to his yields of gasoline and middle distillates, particularly the ligher middle distillates such as JP-4 type jet fuel. The refiners interviewed by the Board indicated a preference for the heavier gravity pentanes plus due to the nature of their market requirements for refined products in Alberta and fringe markets. Demand for heavier gravity pentanes plus is particularly important to a refiner without thermal or

catalytic cracking facilities for controlling the yield pattern of his crude oil feedstocks.

In addition to the types of petroleum products required to meet the needs of Alberta consumers, the actual volume of pentanes plus which will be used in Alberta will be determined by such factors as the type of processing equipment in local refineries and the relative price of pentanes plus to crude oil. The Board has assumed that these factors are reflected in the estimates of pentanes plus requirements presented to the Board by the major refiners.

In general, the Board found relatively close agreement between the estimates of pentanes plus requirements presented to it by both the applicants and the refiners. Based on its own analysis of these requirements in Alberta, the Board feels that the figures presented in Table B-9 for a thirty-year period represent a reasonable forecast of pentanes plus demand by Alberta refineries.

TABLE B-1

FORECASTED TREND IN THE CONSUMPTION OF PROPANE ON ALBERTA FARMS

	1960			1970			1980			1990		
	PRINCIPAL HEATING FUEL		OTHER FUEL USES (1)	PRINCIPAL HEATING FUEL		OTHER FUEL USES (1)	PRINCIPAL HEATING FUEL		OTHER FUEL USES (1)	PRINCIPAL HEATING FUEL		OTHER FUEL USES (1)
	No. OF FARM DWELLINGS	% OF TOTAL	No. OF FARM DWELLINGS	No. OF FARM DWELLINGS	% OF TOTAL	No. OF FARM DWELLINGS	No. OF FARM DWELLINGS	% OF TOTAL	No. OF FARM DWELLINGS	No. OF FARM DWELLINGS	% OF TOTAL	No. OF FARM DWELLINGS
NATURAL GAS	2,500	3.2	2,500	4,500	6.0		6,000	8.0		7,000	10.0	
FUEL OIL	20,100	25.8		21,000	28.0		22,000	30.5		22,700	32.5	
COAL	36,000	46.1	43,600	32,170	43.0		17,600	24.5		12,500	17.5	
WOOD	14,800	19.0										
ELECTRICITY			25,200									
PROPANE	4,600	5.9	15,200	17,330	23.0	35,000	26,400	37.0	37,250	27,850	40.0	40,000
	78,000	100.0		75,000	100.0		72,000	100.0		70,000	100.0	
AVERAGE PROPANE CONSUMPTION - GALLONS PER YEAR	1,600(2)		300	1,650(2)		350	1,700(2)		400	1,700(2)		400
TOTAL CONSUMPTION - GALLONS	7,360,000		4,560,000	28,590,000		12,250,000	44,880,000		14,900,000	47,345,000		16,000,000

(1) INCLUDES OTHER FUEL USES SUCH AS COOKING, HOT WATER HEATING, AUXILIARY SPACE HEATING AND SPECIAL FARM APPLICATIONS SUCH AS CROP DRYING AND FUEL FOR BROODERS. THE NUMBER OF DWELLINGS USING TWO OR MORE FUELS CAUSES "OTHER FUEL USERS" TO EXCEED TOTAL NUMBER OF DWELLINGS.

(2) IT HAS BEEN ASSUMED THAT WHERE PROPANE IS USED AS THE PRINCIPAL HEATING FUEL, IT WILL ALSO BE USED FOR WATER HEATING.

TABLE B-2

FORECASTED TREND IN ALBERTA CONSUMPTION OF PROPANE AS A PRINCIPAL HEATING FUEL IN NON-FARM RURAL DWELLINGS

	1960		1970		1980		1990	
	No. of Dwellings	% of Total	No. of Dwellings	% of Total	No. of Dwellings	% of Total	No. of Dwellings	% of Total
Natural gas	14,700	35.0	19,800	45.0	23,500	50.0	27,500	55.0
Fuel Oil	12,600	30.0	12,760	29.0	13,160	28.0	13,500	27.0
Coal)) Wood)	10,500	25.0	6,600	15.0	4,700	10.0	2,500	5.0
Propane	4,200	10.0	4,840	11.0	5,640	12.0	6,500	13.0
Total No. of Non-farm Rural Dwellings	42,000	100.0	44,000	100.0	47,000	100.0	50,000	100.0
Average Propane Consumption - Gallons per year*	1,700		1,750		1,800		1,800	
Total Consumption-Gal	7,140,000		8,470,000		10,150,000		11,700,000	

* Average consumption of propane per dwelling allows for other fuel uses such as cooking and water heating in both dwellings using and not using propane as the principal heating fuel.

TABLE B-3

FORECASTED TREND IN ALBERTA CONSUMPTION OF PROPANE BY DOMESTIC AND COMMERCIAL USERS

Gallons at 60°F

	1960	% of Total	1970	% of Total	1980	% of Total	1990	% of Total
FARM								
Principal Heating Fuel	7,360,000	29.0	28,590,000	49.5	44,880,000	55.5	47,345,000	52
Other Fuel Uses	4,560,000	18.0	12,250,000	21.0	14,900,000	18.5	16,000,000	18
Rural Non-farm	7,140,000	28.0	8,470,000	15.0	10,150,000	12.5	11,700,000	13
Commercial	5,200,000	20.0	6,240,000	11.0	8,060,000	10.0	10,775,000	12
Misc. Cylinder Users	1,290,000	5.0	2,000,000	3.5	3,000,000	3.5	4,000,000	4
Consumption in Gallons per year	25,550,000	100.0	57,550,000	100.0	80,990,000	100.0	89,800,000	100
Average barrels per day	2,000		4,505		6,340		7,030	

TABLE B-4

DOMESTIC AND COMMERCIAL DEMAND FOR PROPANE - ALBERTA - 1961 - 1972 (bpd)

YEAR	BOARD	FOOTHILLS-WESTALTA (1)	BRITAMOIL (2)	HYDROCARBONS
1961	2,300			
1962	2,400	3,370		2,650
1963	2,600	3,710	3,500	2,840
1964	2,900	4,080		3,060
1965	3,200	4,490	4,800	3,290
1966	3,500	4,715		3,540
1967	3,800	4,950		3,810
1968	4,100	5,200		4,090
1969	4,300	5,460		4,400
1970	4,500	5,735	6,600	4,720
1971	4,700	6,020		5,070
1972	4,900	6,320		

(1) Includes fringe markets.

(2) Based on assumption that Alberta share of total Western Canada residential and commercial consumption is equal to following percentages of figures shown in Table XV of the Stanford study: 1963, 40%; 1965, 38%; 1970, 35%.

TABLE B-5

FORECASTS OF PROPANE REQUIREMENTS FOR ALBERTA - 1961-1990

- BARRELS PER DAY -

	BOARD						APPLICANTS			
YEAR	DOMESTIC & COMMERCIAL	PETRO-CHEMICALS	INTERNAL COMBUSTION(1)	INDUSTRIAL(1)	MISCIBLE FLOOD	TOTAL	FOOTHILLS WESTALTA(1)	BRITAMOIL	HYDROCARBONS	PROVINCIAL PRODUCTS (2)
1961	2,300	1,400	100	100	1,100	5,000				4,400
1962	2,400	1,600	100	100	1,600	5,800	5,900		6,480	4,500
1963	2,600	1,800	200	100	2,000	6,700	6,300	6,400	6,970	4,700
1964	2,900	2,100	200	100	2,200	7,500	6,900		7,500	5,000
1965	3,200	2,400	300	200	2,300	8,400	7,500	9,100	8,050	5,700
1966	3,500	2,700	300	200	2,500	9,200	7,900		8,630	5,900
1967	3,800	3,000	400	200	2,500	9,900	8,300		9,240	6,200
1968	4,100	3,300	500	200	2,500	10,600	8,800		9,870	6,500
1969	4,300	3,600	500	300	2,500	11,200	9,200		10,540	6,900
1970	4,500	3,900	600	300	2,500	11,800	9,800	13,000	11,250	7,100
1971	4,700	4,200	700	300	2,500	12,400	10,400		11,990	
1972	4,900	4,500	800	300	2,500	13,000	11,000			
1973	5,100	4,800	900	400	2,500	13,700				
1974	5,300	5,100	900	500	2,500	14,300				
1975	5,500	5,400	1,000	500	2,500	14,900				
1976	5,700	5,700	1,100	500	2,500	15,500				
1977	5,900	6,000	1,200	500	2,500	16,100				
1978	6,100	6,300	1,300	500	2,500	16,700				
1979	6,300	6,600	1,300	600	2,500	17,300				
1980	6,400	6,900	1,400	600	2,500	17,800				
1981	6,500	7,300	1,400	700	2,400	18,300				
1982	6,600	7,600	1,500	700	2,400	18,800				
1983	6,700	8,000	1,500	700	2,300	19,200				
1984	6,800	8,400	1,600	800	2,300	19,900				
1985	6,900	8,800	1,600	800	2,200	20,300				
1986	6,900	9,200	1,700	900	2,200	20,900				
1987	7,000	9,600	1,700	900	2,100	21,300				
1988	7,000	10,100	1,800	900	2,100	21,900				
1989	7,000	10,700	1,800	1,000	2,000	22,500				
1990	7,100	11,300	1,900	1,000	2,000	23,300				

(1) INCLUDES REQUIREMENTS IN FRINGE AREAS

(2) EXCLUDES MISCIBLE FLOOD REQUIREMENTS

TABLE B-6

FORECASTS OF PROPANE REQUIREMENTS FOR ALBERTA AND FRINGE MARKETS - 1961-1990

- BARRELS PER DAY -

YEAR	ALBERTA REQUIREMENTS	FRINGE AREA REQUIREMENTS	ALBERTA AND FRINGE AREA REQUIREMENTS	FOOTHILLS - WESTALTA ESTIMATE(*)
1961	5,000	500	5,500	
1962	5,800	400	6,200	5,900
1963	6,700	400	7,100	6,300
1964	7,500	500	8,000	6,900
1965	8,400	500	8,900	7,500
1966	9,200	500	9,700	7,900
1967	9,900	600	10,500	8,300
1968	10,600	600	11,200	8,800
1969	11,200	700	11,900	9,200
1970	11,800	700	12,500	9,800
1971	12,400	800	13,200	10,400
1972	13,000	800	13,800	11,000
1973	13,700	900	14,600	
1974	14,200	900	15,100	
1975	14,800	1,000	15,800	
1976	15,500	1,100	16,600	
1977	16,100	1,100	17,200	
1978	16,700	1,200	17,900	
1979	17,300	1,300	18,600	
1980	17,800	1,300	19,100	
1981	18,300	1,300	19,600	
1982	18,800	1,400	20,200	
1983	19,200	1,400	20,600	
1984	19,900	1,400	21,300	
1985	20,300	1,500	21,800	
1986	20,900	1,500	22,400	
1987	21,300	1,500	22,800	
1988	21,900	1,600	23,500	
1989	22,500	1,600	24,100	
1990	23,300	1,600	24,900	

(*) THE FOOTHILLS - WESTALTA GROUP WAS THE ONLY APPLICANT TO ESTIMATE PROPANE DEMAND FOR ALBERTA AND FRINGE MARKETS.

TABLE B-7

FORECASTS OF BUTANE, ISO-BUTANE & LPG MIX REQUIREMENTS FOR ALBERTA - 1961-1990
- BARRELS PER DAY -

	BOARD					APPLICANTS			
YEAR	DOMESTIC COMMERCIAL & INDUSTRIAL (1)	PETRO-CHEMICALS	REFINERIES	MISCIBLE FLOOD	TOTAL	FOOTHILLS - WESTALTA	BRITAMOIL	HYDROCARBONS	PROVINCIAL PRODUCTS (2)
1961	100	600	1,200	1,100	3,000				1,000
1962	100	400	1,400	1,600	3,500	2,800		2,750	1,000
1963	100	300	1,500	1,100	3,000	3,000	3,200	2,900	1,000
1964	100	200	1,600	1,200	3,100	3,200		3,060	2,000
1965	200	700	1,700	1,200	3,800	5,500	3,600	3,220	2,000
1966	200	900	1,700	1,300	4,100	5,700		3,390	2,000
1967	200	1,100	1,800	1,300	4,400	6,000		3,550	2,000
1968	200	1,200	1,900	1,300	4,600	6,300		3,720	2,000
1969	200	1,300	2,000	1,300	4,800	6,700		3,890	3,000
1970	300	1,600	2,000	1,300	5,200	7,000	4,900	4,060	3,000
1971	300	1,700	2,100	1,300	5,400	7,400		4,285	
1972	300	1,800	2,200	1,300	5,600	7,800			
1973	300	1,900	2,300	1,300	5,800				
1974	300	2,100	2,400	1,300	6,100				
1975	400	2,300	2,500	1,300	6,500				
1976	400	2,500	2,600	1,300	6,800				
1977	400	2,700	2,700	1,300	7,100				
1978	400	2,900	2,800	1,300	7,400				
1979	400	3,100	2,900	1,300	7,700				
1980	400	3,300	3,000	1,300	8,000				
1981	400	3,500	3,100	1,300	8,300				
1982	400	3,700	3,200	1,200	8,500				
1983	400	3,900	3,400	1,200	8,900				
1984	500	4,100	3,500	1,100	9,200				
1985	500	4,300	3,700	1,100	9,600				
1986	500	4,500	3,800	1,100	9,900				
1987	500	4,700	4,000	1,000	10,200				
1988	500	5,000	4,100	1,000	10,600				
1989	500	5,300	4,300	1,000	11,100				
1990	500	5,500	4,400	900	11,300				

(1) INCLUDES REQUIREMENTS IN FRINGE AREAS

(2) EXCLUDES MISCIBLE FLOOD REQUIREMENTS

TABLE B-8

OIL AND GAS CONSERVATION BOARD ESTIMATES OF
LPG REQUIREMENTS FOR MISCIBLE FLOODING IN ALBERTA - 1961-1990
- BARRELS PER DAY -

YEAR	REQUIREMENTS FOR EXISTING OIL RESERVOIRS		REQUIREMENTS FOR FUTURE OIL DISCOVERIES (TWO-YEAR TREND)		TOTAL		TOTAL PROPANE AND BUTANE
	PROPANE	BUTANE	PROPANE	BUTANE	PROPANE	BUTANE	
1961	1,100	1,100	-	-	1,100	1,100	2,200
1962	1,600	1,600	-	-	1,600	1,600	3,200
1963	2,000	1,100	-	-	2,000	1,100	3,100
1964	2,200	1,200	-	-	2,200	1,200	3,400
1965	2,300	1,200	-	-	2,300	1,200	3,500
1966	2,400	1,200	100	-	2,500	1,300	3,800
1967	2,200	1,200	300	100	2,500	1,300	3,800
1968	2,200	1,200	300	100	2,500	1,300	3,800
1969	2,200	1,200	300	100	2,500	1,300	3,800
1970	2,200	1,200	300	100	2,500	1,300	3,800
1971	2,200	1,200	300	100	2,500	1,300	3,800
1972	2,200	1,200	300	100	2,500	1,300	3,800
1973	2,200	1,200	300	100	2,500	1,300	3,800
1974	2,200	1,200	300	100	2,500	1,300	3,800
1975	2,200	1,200	300	100	2,500	1,300	3,800
1976	2,200	1,200	300	100	2,500	1,300	3,800
1977	2,200	1,200	300	100	2,500	1,300	3,800
1978	2,200	1,200	300	100	2,500	1,300	3,800
1979	2,200	1,200	300	100	2,500	1,300	3,800
1980	2,200	1,200	300	100	2,500	1,300	3,800
1981	2,100	1,000	300	100	2,400	1,300	3,700
1982	2,100	1,100	300	100	2,400	1,200	3,600
1983	2,000	1,100	300	100	2,300	1,200	3,500
1984	2,000	1,000	300	100	2,300	1,100	3,400
1985	1,900	1,000	300	100	2,200	1,100	3,300
1986	1,900	1,000	300	100	2,200	1,100	3,300
1987	1,800	900	300	100	2,100	1,000	3,100
1988	1,800	900	300	100	2,100	1,000	3,100
1989	1,700	900	300	100	2,000	1,000	3,000
1990	1,700	800	300	100	2,000	900	2,900

TABLE B-9

FORECASTS OF CONDENSATE AND NATURAL GASOLINE (PENTANES PLUS) REQUIREMENTS FOR ALBERTA - 1961-1990

- BARRELS PER DAY -

	APPLICANTS				
YEAR	BOARD	FOOTHILLS - WESTALTA	BRITAMOIL	HYDROCARBONS	PROVINCIAL PRODUCTS
1960*	7,100	-	6,000	-	-
1961	11,000	-	-	-	15,900
1962	14,000	14,500	-	14,100	17,200
1963	17,000	16,000	15,000	15,700	18,500
1964	20,000	18,000		17,300	19,800
1965	23,000	20,000	20,000	19,000	21,200
1966	25,000	21,400		20,800	22,400
1967	26,500	22,900		22,700	23,600
1968	28,000	24,500		24,600	24,800
1969	29,000	26,200		26,600	26,000
1970	30,000	28,000	30,000	28,600	27,100
1971	31,000	30,000		30,700	
1972	32,000	32,000			
1973	33,000				
1974	34,500				
1975	35,500				
1976	36,500				
1977	38,000				
1978	39,500				
1979	41,000				
1980	42,000				
1981	43,500				
1982	45,000				
1983	47,000				
1984	48,500				
1985	50,000				
1986	52,000				
1987	54,000				
1988	55,500				
1989	57,500				
1990	59,500				

* ACTUAL

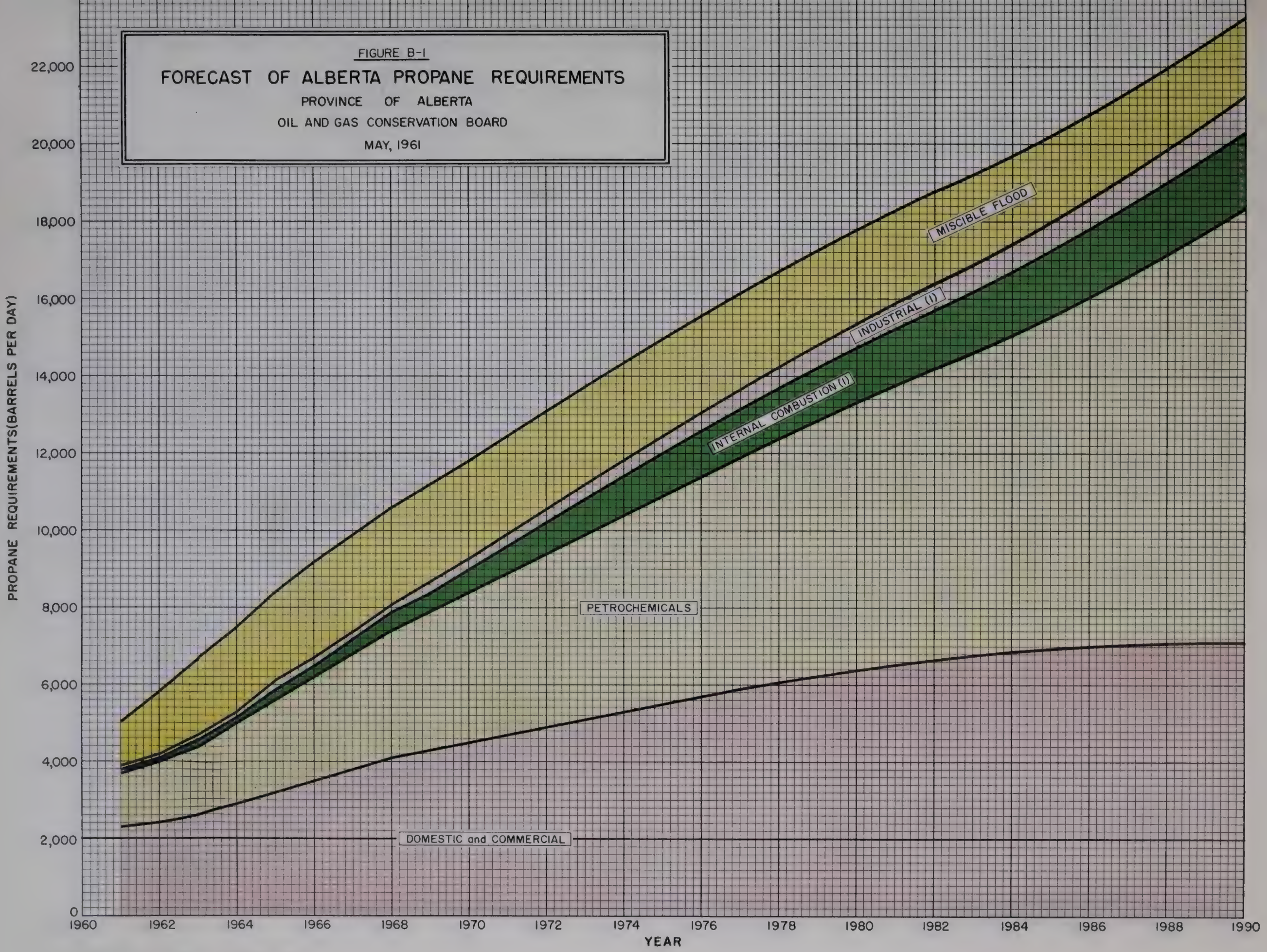
FIGURE B-1

FORECAST OF ALBERTA PROPANE REQUIREMENTS

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961



(1) Includes Requirements In Fringe Areas

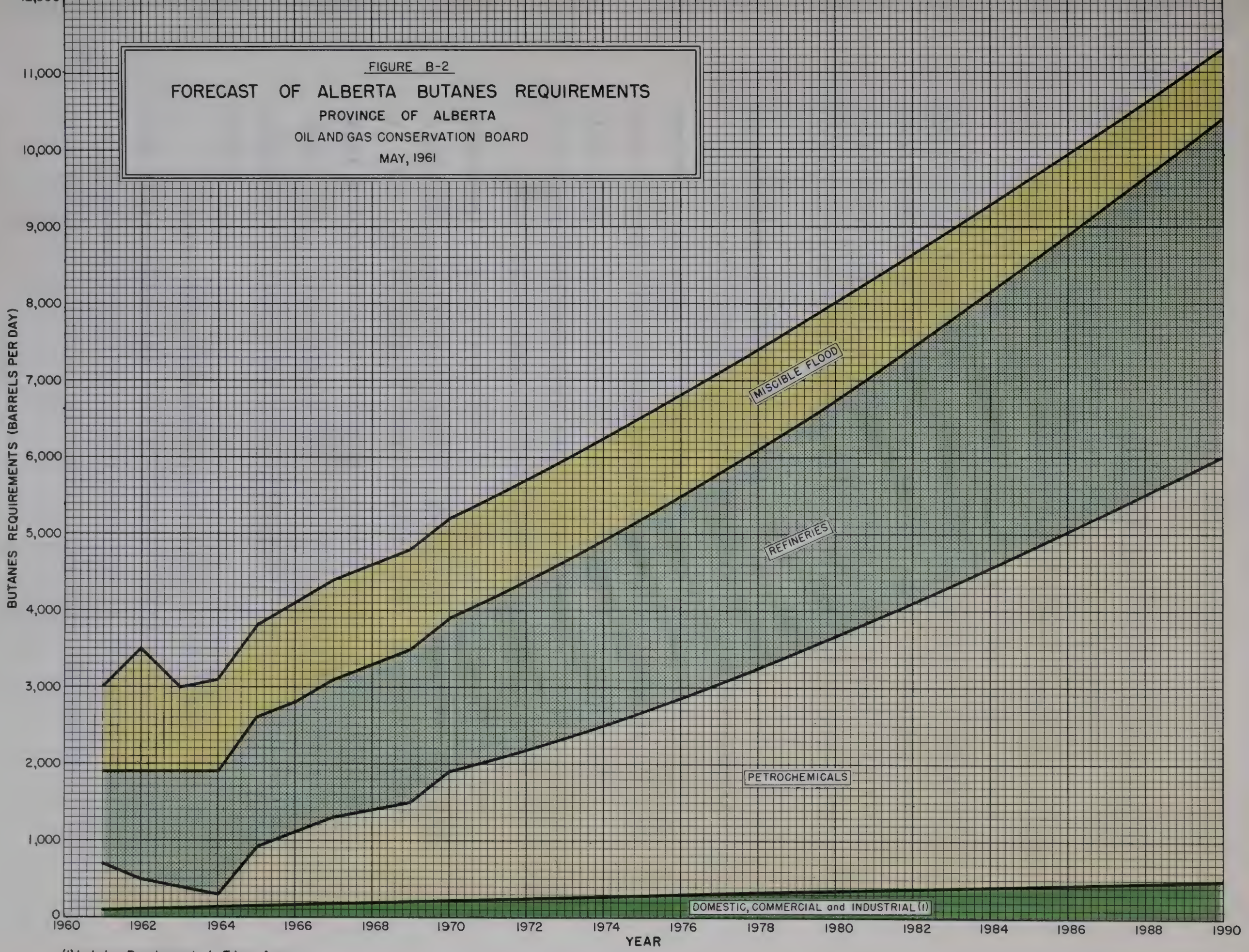
FIGURE B-2

FORECAST OF ALBERTA BUTANES REQUIREMENTS

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961



(1) Includes Requirements In Fringe Areas

APPENDIX C

THE PRESENT AND FUTURE REQUIREMENTS OF AREAS IN CANADA ADJACENT TO ALBERTA FOR NATURAL GAS LIQUIDS

Propane distribution patterns in the past have tended to include south-eastern British Columbia and the western-most portion of Saskatchewan as part of the marketing area served by Alberta gas plants. Alberta and fringe marketing areas as defined by the Board are illustrated in Figure C-1.

South-eastern British Columbia

The area in British Columbia which may be considered as a fringe market of Alberta has been restricted by the Board to the area encompassed by Census Division No. 1. In 1956 this census division contained 666 farm dwellings, 3,694 non-farm dwellings and 3,775 urban dwellings.

The propane market in south-eastern British Columbia has been largely developed in urban areas and, due to the scheduled provision of natural gas to all the urban centres in this region in late 1961 or early 1962, it is expected that a substantial decline in propane sales will occur in 1962. It is also likely that natural gas will be made available to the larger villages in this area in subsequent years.

Propane distributors expect that it will take five to six years before the loss of propane markets in such centres as Cranbrook, Kimberley and Fernie can be offset by the development of markets in surrounding farm and non-farm

rural areas. Only modest rates of growth are forecast to occur in this area after this period of adjustment as shown in Table C-1.

The Board feels that butanes sales in this area will remain relatively negligible.

Saskatchewan

In general terms, the region of Saskatchewan which the Board has considered to be peripheral to the Alberta market would include the area covered by Census Divisions 4, 8, 13 and 17 in the westernmost portion of the Province. The distribution of households in this area in 1956 was as follows:

	Rural Farm	Rural Non-Farm	Urban
Census Division 4	2,556	1,331	1,233
Census Division 8	4,268	2,772	4,219
Census Division 13	4,208	2,527	1,946
Census Division 17	4,175	2,268	1,358
TOTAL	15,207	8,898	8,756

Both farm and rural non-farm dwellings in western Saskatchewan represent approximately 20 per cent of the total dwellings in these categories in Alberta. Natural gas is generally available throughout this area, although the provision of this service has not developed as intensively as in Alberta to this date. However, long-term market estimates have been based on the assumption that all towns with populations in excess of 1,000 persons, in

addition to some smaller towns and villages, will be supplied with natural gas in the foreseeable future. Consequently, as in the case of Alberta, the number of occupied dwellings in farm and non-farm rural areas was considered as the major determinant in establishing the size of the propane market. Consideration was also given to the less competitive position of propane with respect to other fuels, particularly fuel oil, in Saskatchewan due to costs of transportation which will add 4 to 5 cents per gallon to average propane prices prevailing in Alberta.

Due primarily to competition from other types of fuel and the added competition from refinery propane, the Board feels that the proportion of dwellings using Alberta propane in the fringe area of Saskatchewan will not reach the levels predicted to occur in Alberta. It is estimated that in 1961, the western region of Saskatchewan will absorb some 285 barrels per day of propane. This is approximately 12 per cent of the expected consumption of propane by domestic and commercial users in Alberta. By 1965, this area of Saskatchewan may consume quantities of propane equal to some 12.5 per cent of Alberta consumption in the domestic and commercial category and increase to approximately 13.5 per cent by 1970. By the end of the forecast period, the Board expects that western Saskatchewan consumption of Alberta propane by domestic and commercial users will reach something in the order of 17 per cent of the consumption expected in this

category in Alberta at that time.

The 1956 census reported approximately 21,000 tractors in the four census divisions of Saskatchewan considered peripheral to the Alberta market. Estimates of the impact of propane consumption by tractors in this area has not been attempted by the Board. It is considered, however, that sufficient leeway exists in the internal combustion end-use estimates for Alberta to cover potential tractor use of propane in western Saskatchewan. Propane consumption by industrial users in western Saskatchewan has been treated similarly by increasing the forecast consumption of propane in this end-use in Alberta.

The demand for butanes in western Saskatchewan is expected to be relatively insignificant over the forecast period.

The Board's thirty-year forecast of total propane sales in markets peripheral to Alberta is shown in Table B-5.

Table C-1 sets out expected trends in sales of propane in the domestic and commercial demand category in south-eastern British Columbia and western Saskatchewan from 1961 to 1970 and for selected years thereafter.

TABLE C-1

ESTIMATED DOMESTIC AND COMMERCIAL REQUIREMENTS FOR ALBERTA PROPANE - FRINGE MARKETS IN BRITISH COLUMBIA AND SASKATCHEWAN

(Amounts in Barrels per day)

YEAR	BRITISH COLUMBIA	SASKATCHEWAN	TOTAL
1961	215	285	500
1962	105	295	400
1963	90	310	400
1964	100	400	500
1965	100	400	500
1966	100	400	500
1967	100	500	600
1968	100	500	600
1969	100	600	700
1970	100	600	700
1975	140	860	1,000
1980	230	1,070	1,300
1985	300	1,200	1,500
1990	365	1,235	1,600

FIGURE C-1

MAP OF

ALBERTA

SHOWING

FRINGE MARKETING AREAS

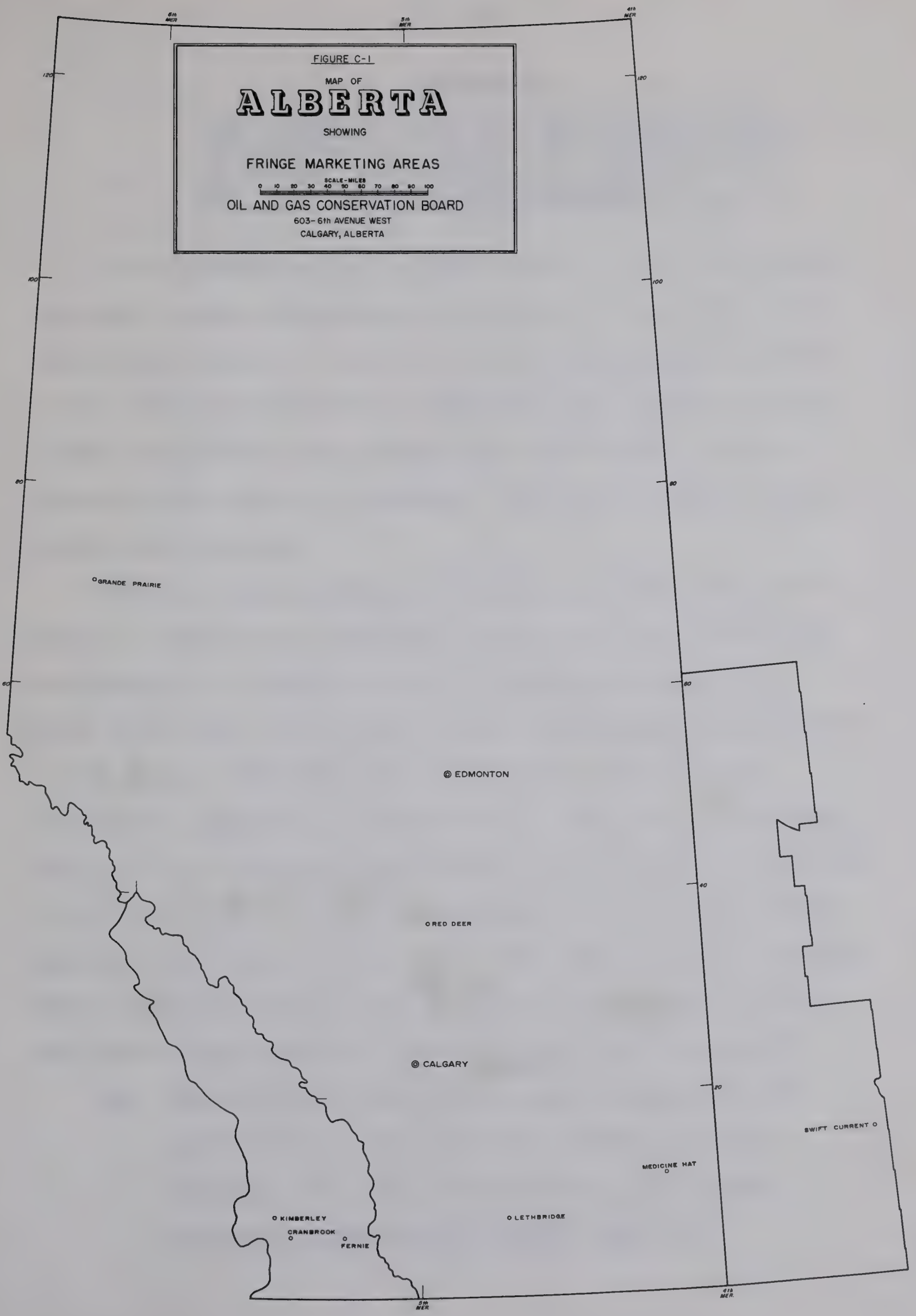
SCALE - MILES

0 10 20 30 40 50 60 70 80 90 100

OIL AND GAS CONSERVATION BOARD

603 - 6th AVENUE WEST

CALGARY, ALBERTA



MAY, 1961

APPENDIX D

THE MANNER IN WHICH THE PRESENT AND FUTURE REQUIREMENTS OF ALBERTA AND ADJACENT AREAS IN CANADA FOR NATURAL GAS LIQUIDS MAY BE MET, AND THE RESULTING SURPLUSES

As discussed earlier in this report, one of the Board's concerns is with the meeting of Alberta's requirements for propane and butanes. However, because the possible export of the surplus quantities of these products depends so much on the availability of pentanes plus, the Board in this appendix deals with the potential surplus of each of these natural gas liquids.

The most obvious manner in which to balance the production of natural gas liquids within the Province with the requirements for these products of Alberta and adjacent areas in Canada, is to subtract the total annual requirements of these areas for each product from the total annual provincial production of the product. Prior to considering the problem of meeting requirements in such a general manner, it is in the Board's opinion necessary to investigate three important features of the supply and demand picture, each of which may be critical in the meeting of Alberta's natural gas liquid requirements. These features are as follows:

(a) the ability of provincial natural gas liquids production to meet seasonal demand for these products, the role of storage in the meeting of these seasonal peak demands, and the

resulting load factor of any available surpluses;

(b) the distribution of natural gas liquids production and demand on a regional basis, and the ability to meet the demand economically for each product by areas, having regard for existing and contemplated storage and pipe line facilities; and

(c) the adaptability of the products produced in Alberta to the requirements from the view-point of composition. This refers specifically to the suitability of the available pentanes and heavier hydrocarbons as a feedstock for local refineries, and to the quality of any liquids that may be surplus to Alberta's requirements.

The Board has carefully studied each of these three features, and is presenting the details of these studies as section 6 of its report to the Department of Mines and Minerals on the pipe line permit applications referred to in this report. The following is a resumé of the Board's views regarding these matters:

1. In the Board's opinion the meeting of Alberta's seasonal peak requirements for natural gas liquids will present no serious problem in the future.

A detailed study of the seasonal patterns for the supply of and the demand for propane has

been completed by the Board. Because a major use of propane is for space heating, the winter demand is considerably greater than the summer demand. The study reveals that when the processing plants necessary to serve the presently approved projects for the removal of gas from the Province are all on stream, the total annual production of propane need exceed the total requirements for the same year by only some 20 per cent, and the seasonal peak requirements could be met. It also reveals that if total annual production and requirements of propane for any particular year should be equal, the effective use of some 75 per cent of the existing underground storage and some 10 per cent of the anticipated plant storage for the product could also result in the meeting of the seasonal peak demands.

It is likely that annual production will actually exceed requirements by appreciably greater amounts than 20 per cent; and it is also possible that due to the ownership of product, the economics of available storage, and the demand pattern by areas, the existing underground and plant storage may be effectively utilized to a greater degree than mentioned above.

For these reasons, and because future requirements for miscible flooding also afford some opportunity to level annual requirements, the Board concludes that any future surplus of propane that occurs within the Province should be available for extraprovincial shipment on a year-round basis, with a seasonal load factor of 80 per cent or higher.

A similar study of the seasonal production and requirement patterns for butanes has been completed. The major use for butanes in Alberta is in the refining industry, and the over-all demand pattern indicates that peak requirements occur in the spring and fall months.

The study reveals that if the total annual production of butanes should exceed requirements by some 20 per cent, the seasonal peak demands for this product could be met without use of plant or refinery storage. It also indicates that if total annual requirements and production of butanes for any particular year should be equal, the effective use of some 60 per cent of anticipated plant storage could result in the meeting of seasonal peak demands. With the knowledge that annual production will exceed requirements by a considerable amount, that some use may be

made of the available refinery storage for raw materials as well as the plant storage, and that the future requirements for miscible flooding should have a levelling affect on the year-round requirements, the Board concludes that the seasonal peak demands for butanes can be met in the foreseeable future without serious problems. It also concludes that any surplus of butanes in the Province would exist on a year-round basis, and could be made available for extraprovincial shipment with a load factor of 75 per cent or higher.

The Board has also studied the seasonal production and requirement patterns for pentanes plus within the Province. Because the major use for these products is in the refining industry, the demand pattern is opposite to that of propane, and the peak requirements occur during the summer months. The study indicates that if the total annual pentanes plus production should exceed requirements by some 40 per cent, the seasonal peak demands could be met without use of plant or refinery storage. It also indicates that if total annual requirements and production of these products for any particular year should be equal, the effective use of up to 100 per cent of

anticipated plant storage would still not result in the meeting of seasonal peak demands. Since the refinery storage for these materials has not been included in this study, and since in many refineries there is some flexibility as to the amount of these liquids that can be blended with oil as a feedstock, the Board concludes that the seasonal peak demands for pentanes plus can be met in the future without any serious problems, and that any surpluses that exist will be available on a year-round basis with a seasonal load factor of at least 75 per cent.

2. In the Board's opinion, the meeting of Alberta's requirements for natural gas liquids by specific areas is not likely to present a serious economic problem in the future.

A study of the demand for and production of these liquids within the Province on a regional basis has been completed by the Board. The study indicates that the future propane and butanes production and markets will be largely in the central portion of the Province oriented around Edmonton. The area is estimated to be in a surplus position with regard to these products.

The study also indicates that the southern

portion of the Province, centring around Calgary, will be in a deficit position with respect to propane and butanes. It is estimated that movements into this area from the north will satisfy these deficiencies.

There will be, on the basis of the study, a deficit for propane in the Peace River area in the immediate future. Since a substantial part of this requirement is met from British Columbia production, and since the total requirement of this area is a very small portion of provincial requirements, the Board has concluded that this situation will not create a serious problem.

It is also estimated that the future requirements and production of pentanes plus will be fairly evenly divided between the south and the central areas of the Province, and that each of the areas will be more than self-sufficient as to requirements for these products.

3. The Board estimates that the available pentanes plus will in all probability be able to satisfy the quality specifications of the future requirements for the refining industry without serious problems.

The Board has studied the various types of condensates and natural gasolines being produced

in the Province, and the areas in which these liquids are being produced. It has estimated that a fairly significant part of the future pentanes plus production will be natural gasolines or light condensates which are not as desirable as heavy condensates for refinery purposes.

The requirements of refineries for heavy condensates has also been studied and the Board concludes that the production of these condensates within the Province will be sufficient to meet the requirements. It is likely that there will be some movement of these heavy condensates out of the Province, thus reducing the quantities available for use at local refineries. Nevertheless, the Board concludes that through the use of condensates in conjunction with crude oil and by selective design of future refining facilities, the production will be able to satisfy the requirements from a quality point of view.

A great deal of evidence regarding the production of and the demand for natural gas liquids in the Province was submitted to the Board at the hearings. This evidence has been discussed in detail in Appendices A, B and C of this report. In this appendix the Board discusses the surpluses of liquids that would result if the forecasts of provincial

production and requirements as submitted by each of the applicants were accepted, and also presents and discusses the surplus resulting from the Board's estimates. It must be noted as set out in the previously mentioned appendices, that the basis for the production and requirement forecasts as submitted by each of the applicants and as prepared by the Board were not identical. This makes a meaningful comparison of the forecast surpluses difficult.

The evidence submitted at the Foothills-Westalta hearings, indicated that the liquids surplus to provincial requirements will total some 68,000 barrels per day by 1962, and will increase to more than 130,000 barrels per day by 1970. The 1962 daily surplus would be made up of about 11,000 barrels of propane, 14,000 barrels of butanes and 43,000 barrels of pentanes plus. These surpluses would increase by 1970 to some 26,000 barrels per day of propane, 29,000 barrels per day of butanes and 76,000 barrels per day of pentanes plus.

Evidence submitted on behalf of Britamoil indicated that under minimum recovery conditions, a liquid surplus of some 50,000 barrels per day would materialize by 1965 and would remain essentially level throughout the five additional years covered in its forecast. Under maximum recovery conditions this surplus would increase to some 78,000 barrels per day by 1970. Under minimum recovery conditions the propane, butanes and pentanes plus surpluses would be fairly

level at about 1,000, 7,000 and 44,000 barrels per day respectively. With maximum recovery the propane surplus would increase to about 15,000 barrels per day and the butanes surplus would increase to about 19,000 barrels per day by 1970. The pentanes plus surplus would remain level at some 44,000 barrels per day.

The evidence submitted by Hydrocarbons indicated that the liquids surplus to provincial requirements will increase from some 53,000 barrels per day in 1962 to some 111,000 barrels per day by 1970. The surplus propane over this period would increase from about 3,000 to about 5,000 barrels per day, the surplus butanes would increase from about 8,000 to about 16,000 barrels per day, and the surplus pentanes plus would increase from some 42,000 to some 90,000 barrels per day.

The evidence submitted on behalf of Provincial Products was sufficient to predict surpluses for only pentanes plus. The surplus indicated by this evidence for these products will increase from some 42,000 barrels per day in 1962 to some 56,000 barrels per day by 1970.

The following is a discussion of the surpluses of natural gas liquids that would result from the production and requirement forecasts prepared by the Board.

PROPANE

The Board has prepared and presents as Figures D-1 and

D-2 plots of the provincial propane production and requirements as forecast in Appendices A, B and C of this report. Figure D-1 shows the propane production from established gas reserves as predicted under present economic conditions, and in addition shows production from established reserves plus the forecast minimum production from reserves not yet discovered. It also shows the requirements of propane as forecast in Appendices B and C both for Alberta and for Alberta plus adjacent areas in Canada. The forecast propane production from established reserves has been taken from Table A-1 of this report and the predicted production from not yet discovered reserves has been taken from Table A-6. The production forecasts are presented in such a manner as to illustrate the anticipated thirty-year production from established reserves plus two years' trend gas, from established reserves plus five years' trend gas, and from established reserves plus ten years' trend gas.

It can be seen from Figure D-1 that the propane production from established reserves as forecast under minimum recovery conditions will be sufficient to do little more than meet the Alberta and adjacent area requirements over the next five or six years. If no additional reserves were developed and the predicted deficiency under minimum recovery conditions actually occurred within five or six years, it is likely that the deficit could be eliminated for at least another five years by increasing the plant

recovery factors. If consideration is given to the minimum propane production that is expected from reserves not yet discovered, then the figure shows that a further surplus will develop and in fact will increase slightly over the next ten years.

Figure D-2 presents the same data as is included in Figure D-1, except that it applies to the condition of increased economic incentive to recover propane in the Province. It can be seen from this figure that the predicted maximum propane production from established reserves as set out in Table A-1 of this report is sufficient to meet the requirements of Alberta and adjacent areas until approximately 1972. If the anticipated production from undiscovered reserves is considered, the figure shows that under maximum recovery conditions there is, potentially, a substantial future propane surplus in the Province.

Figure D-3 and D-4 analyse in detail the surplus of propane as forecast under minimum and maximum recovery conditions for the Province over the next ten years.

The Board acknowledges that to be completely consistent with its policy of protecting reserves to meet the present and future provincial requirements of natural gas, it should provide for propane requirements only from established reserves plus those reserves to be discovered during the next two years. Nevertheless it believes that because liquid production is a direct result of gas and oil

production and so to a large degree cannot be controlled, and because even under minimum recovery conditions a propane surplus is predicted from established reserves plus two years of trend gas over the next eight years, some attempt must be made to analyse the long range surplus of this product so that steps can be taken to establish additional markets for the product if necessary. The only alternatives to establishing these additional markets are the flaring of the product which in the interests of conservation cannot be permitted, or the storage of the product for future provincial use which would be a very expensive operation, particularly if a need for the product within the Province does not develop in the near future.

For this reason the Board is prepared to give some consideration to production from reserves to be discovered beyond the next two years, and accordingly has presented in Figures D-3 and D-4 the anticipated propane surplus resulting from presently established reserves and from reserves to be discovered over the next ten years.

It can be seen from Figure D-3 that under minimum recovery conditions the surplus propane production from established reserves plus two years of trend gas will be in the order of 2,500 barrels per day by the year 1965. (The peak in the surplus predicted for the years 1965 and 1966 is in the Board's opinion not significant). It can also be seen that thereafter the production from future

discoveries will increase sufficiently to offset the increase in requirements and the 2,500 barrel per day surplus will be more or less maintained.

Similarily Figure D-4 shows that under conditions of maximum recovery, the propane surplus from established reserves plus two years of trend gas is predicted at about 9,000 barrels per day by 1965. The figure also shows that production from yet to be discovered reserves will probably slightly increase the surplus thereafter. Both figures illustrate that the trend in the surplus, as developed on the basis of production from established reserves plus production from reserves not yet discovered, is towards the maintenance of the approximate 1965 level into the future.

With this in mind, and on the basis of Figures D-3 and D-4, the Board has concluded that a small surplus of propane will develop in the Province beginning in 1962, will increase to some 2,500 barrels per day by 1965 and will remain more or less at this level for a period of from fifteen to twenty years thereafter. It has also concluded that if the acquisition of an additional and substantial market for propane takes place, the economic incentive to recover this product would be increased and the surplus may be as large as 9,000 barrels per day by 1965 and should also remain at this level or even increase for from fifteen to twenty years thereafter. The projection of these

surpluses for a period of from fifteen to twenty years, assumes that the presently established discovery rate for natural gas will be maintained over this period. It also presupposes that it will be possible to market all gas discovered during this period, with an average time lag from date of discovery to date of initial production of some four years. If markets for a portion of this gas cannot be found or if the average time lag should be greater than four years, the result on the projected surplus of natural gas liquids would be to reduce the volumes available and to prolong the period over which they are available.

BUTANES

Figures D-5 and D-6 are plots of the provincial butanes production and requirements as forecast in Appendices A and B of this report. Figure D-5 presents the predicted butanes production from established reserves under the existing economic conditions. It also shows the additional minimum butanes production that is predicted from reserves yet to be discovered. The forecast production has been taken from Tables A-2 and A-6 of this report. Also shown on the plot are the predicted provincial requirements for butanes as taken from Appendix B.

It can be seen from Figure D-5 that even under minimum recovery conditions, there will from established gas reserves be a definite surplus of butanes in the Province

over the next fifteen years. If consideration is given to production from reserves not yet discovered, it can be seen that this surplus is expected to grow considerably.

Figure D-6 presents the butanes production from established gas reserves and from reserves not yet discovered, as predicted for conditions of increased economic incentive to recover these products. It also shows the predicted provincial requirements for butanes. It can be seen from the figure, that under maximum recovery conditions a rather substantial surplus of butanes would develop in the Province over the next few years and exist for a period of at least twenty years.

Figures D-7 and D-8 are detailed pictures of the predicted surplus of butanes in the Province under conditions of minimum plant recovery and maximum plant recovery. The Board has decided to give the same consideration to production of butanes from future reserves as it has given in the case of propane. For this reason the thirty-year projected butanes production from gas reserves to be discovered over the next ten years has been illustrated in these two figures.

Figure D-7 indicates the under minimum recovery conditions, the provincial butane surplus by 1965 will amount to some 7,000 barrels per day from established gas reserves plus two years of trend gas. The figure clearly shows that consideration of future reserves beyond this

two years would result in a sharp increase in the surplus for at least a ten-year period.

Figure D-8 shows that under conditions of maximum recovery, the provincial surplus of butanes from established reserves plus two years of trend gas will amount to some 14,000 barrels per day by the year 1965. It also illustrates that this surplus will, on the basis of future discoveries beyond the two years, increase considerably for a period of at least ten years.

On the basis of Figures D-7 and D-8, and having due regard for the trends in growth and discovery of reserves in the Province, the Board concludes that a surplus of butanes ranging from some 7,000 to 14,000 barrels per day will materialize by the year 1965. The lower limit of 7,000 barrels per day represents the forecast surplus under minimum recovery conditions, while the 14,000 barrels per day represents the forecast surplus under maximum recovery conditions. It has been further concluded that these surpluses will on the basis of future reserves, remain level or increase for a future period of from fifteen to twenty years thereafter. The projection of the butanes surplus for such a period, involves the same assumptions regarding the future discovery and marketing of natural gas, as in the case of propane.

PENTANES PLUS

Figure D-9 is a plot of the predicted pentanes plus

production and requirements in the Province over the next thirty years. The production of these products has been illustrated as forecast from established reserves and from established reserves plus reserves to be discovered over the next ten years. These production estimates have been taken from Tables A-3 and A-6 of this report. The requirements as plotted on Figure D-9 have been taken from Appendix B.

The figure shows that on the basis of established reserves a surplus of pentanes plus is expected in the Province over the next fifteen years. It also shows that on the basis of reserves to be discovered during the next ten years the surplus will exist until at least 1985.

The details of this surplus are illustrated in Figure D-10. It shows that a surplus of some 45,000 barrels per day of pentanes plus will result from production of established reserves plus two years' trend gas, by the year 1965. It also shows that future reserves, to be developed beyond the two-year period, will likely increase this surplus for at least ten years.

The Board concludes that on the basis of Figure D-10, and having regard for the trend in production from reserves not yet discovered, the provincial surplus of pentanes plus will amount to some 45,000 barrels per day by 1965 and will remain at this level for from fifteen to twenty years thereafter. The extension of this surplus for such a period is based on the same assumptions regarding the future

natural gas discovery and marketing rates, as in the case of propane or butanes.

In summary, the Board has concluded that the provincial surplus of natural gas liquids will range from a minimum of 54,500 barrels per day to a maximum of some 68,000 barrels per day by the year 1965. It also predicts that on the basis of reserves not yet discovered, this surplus will be maintained or may even increase for a period of at least fifteen to twenty years thereafter.

FIGURE D-1

PROPANE PRODUCTION AND REQUIREMENTS
MINIMUM PLANT RECOVERY

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

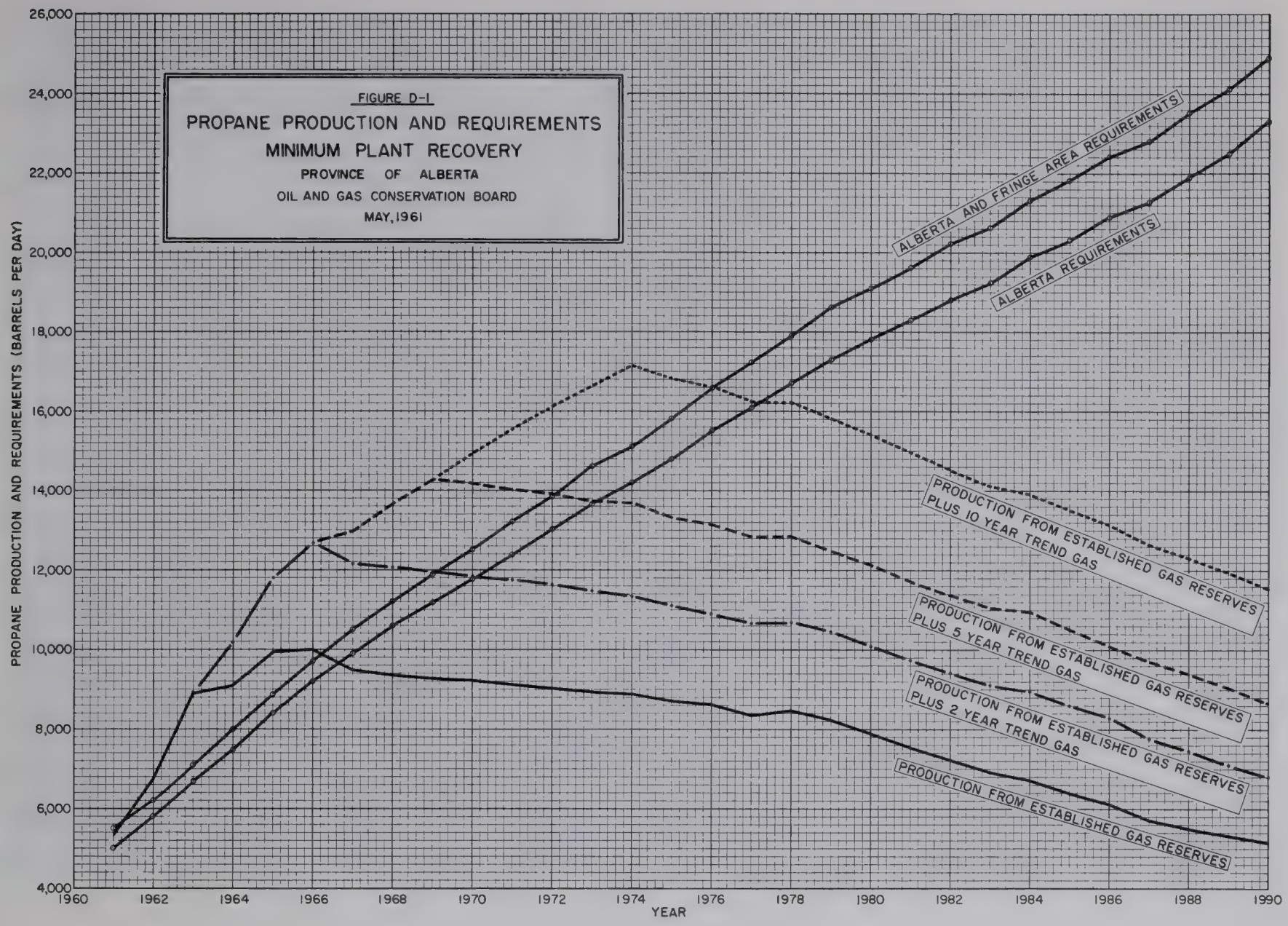


FIGURE D-2

PROPANE PRODUCTION AND REQUIREMENTS
MAXIMUM PLANT RECOVERY

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

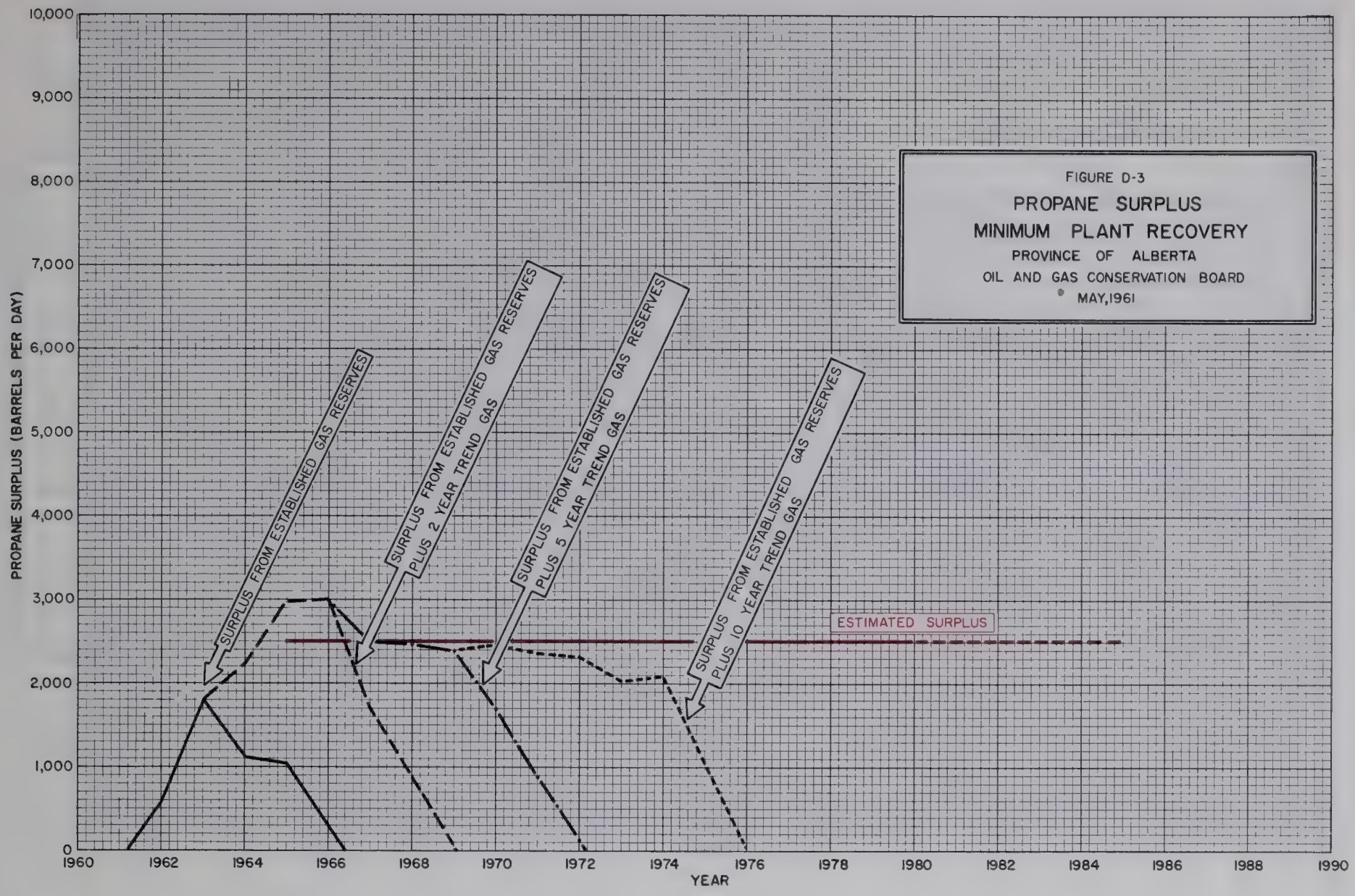


FIGURE D-3
PROPANE SURPLUS
MINIMUM PLANT RECOVERY
PROVINCE OF ALBERTA
OIL AND GAS CONSERVATION BOARD
MAY, 1961
PROPANE SURPLUS (BARRELS PER DAY)
YEAR
ESTIMATED SURPLUS
SURPLUS FROM ESTABLISHED GAS RESERVES
SURPLUS FROM ESTABLISHED GAS RESERVES PLUS 2 YEAR TREND GAS
SURPLUS FROM ESTABLISHED GAS RESERVES PLUS 5 YEAR TREND GAS
SURPLUS FROM ESTABLISHED GAS RESERVES PLUS 10 YEAR TREND GAS

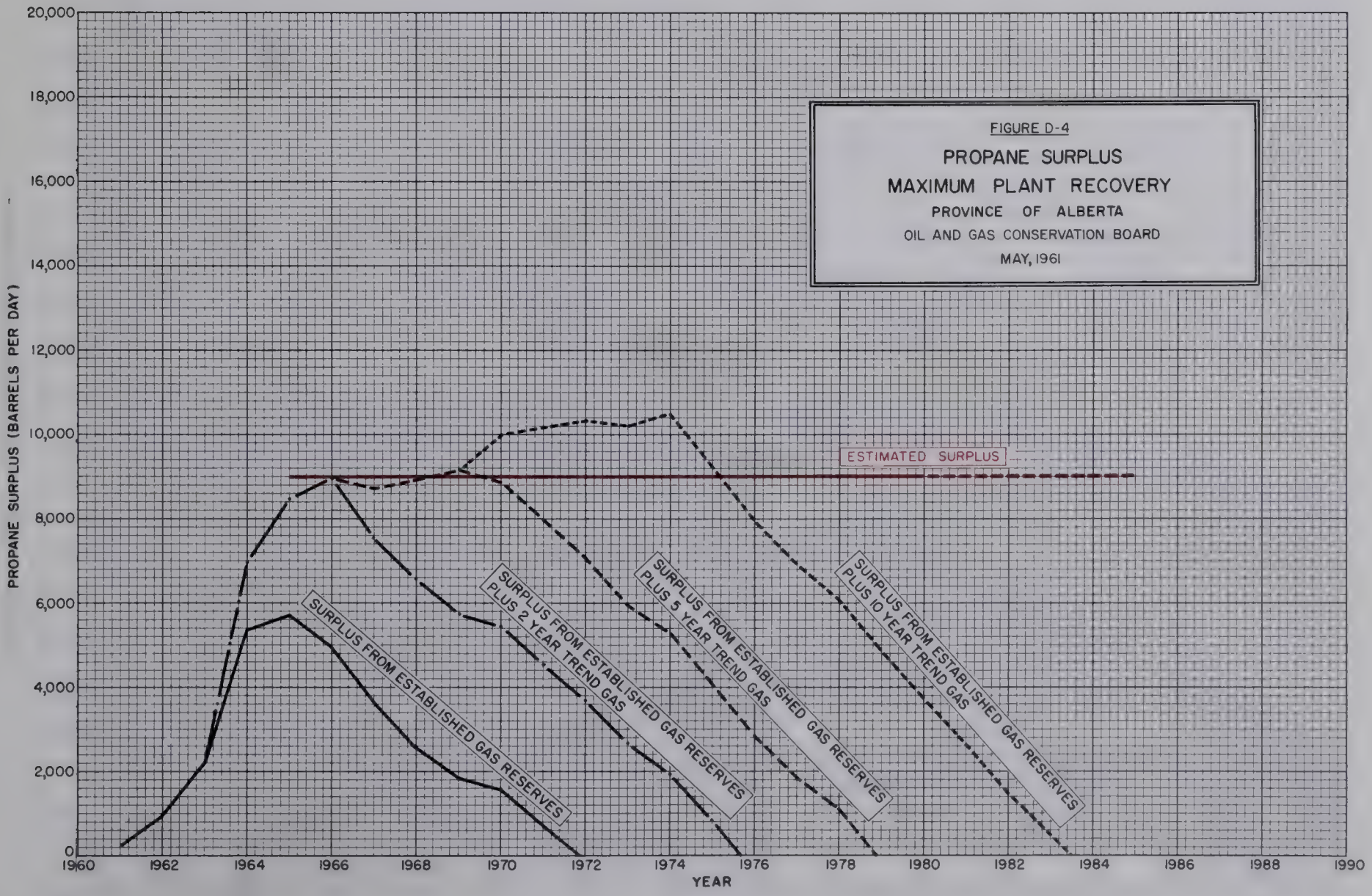


FIGURE D-4
PROPANE SURPLUS
MAXIMUM PLANT RECOVERY
PROVINCE OF ALBERTA
OIL AND GAS CONSERVATION BOARD
MAY, 1961
PROPANE SURPLUS (BARRELS PER DAY)
YEAR
ESTIMATED SURPLUS
SURPLUS FROM ESTABLISHED GAS RESERVES
SURPLUS FROM ESTABLISHED GAS RESERVES PLUS 2 YEAR TREND GAS
SURPLUS FROM ESTABLISHED GAS RESERVES PLUS 5 YEAR TREND GAS
SURPLUS FROM ESTABLISHED GAS RESERVES PLUS 10 YEAR TREND GAS

FIGURE D-5

BUTANES PRODUCTION AND REQUIREMENTS
MINIMUM PLANT RECOVERY

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

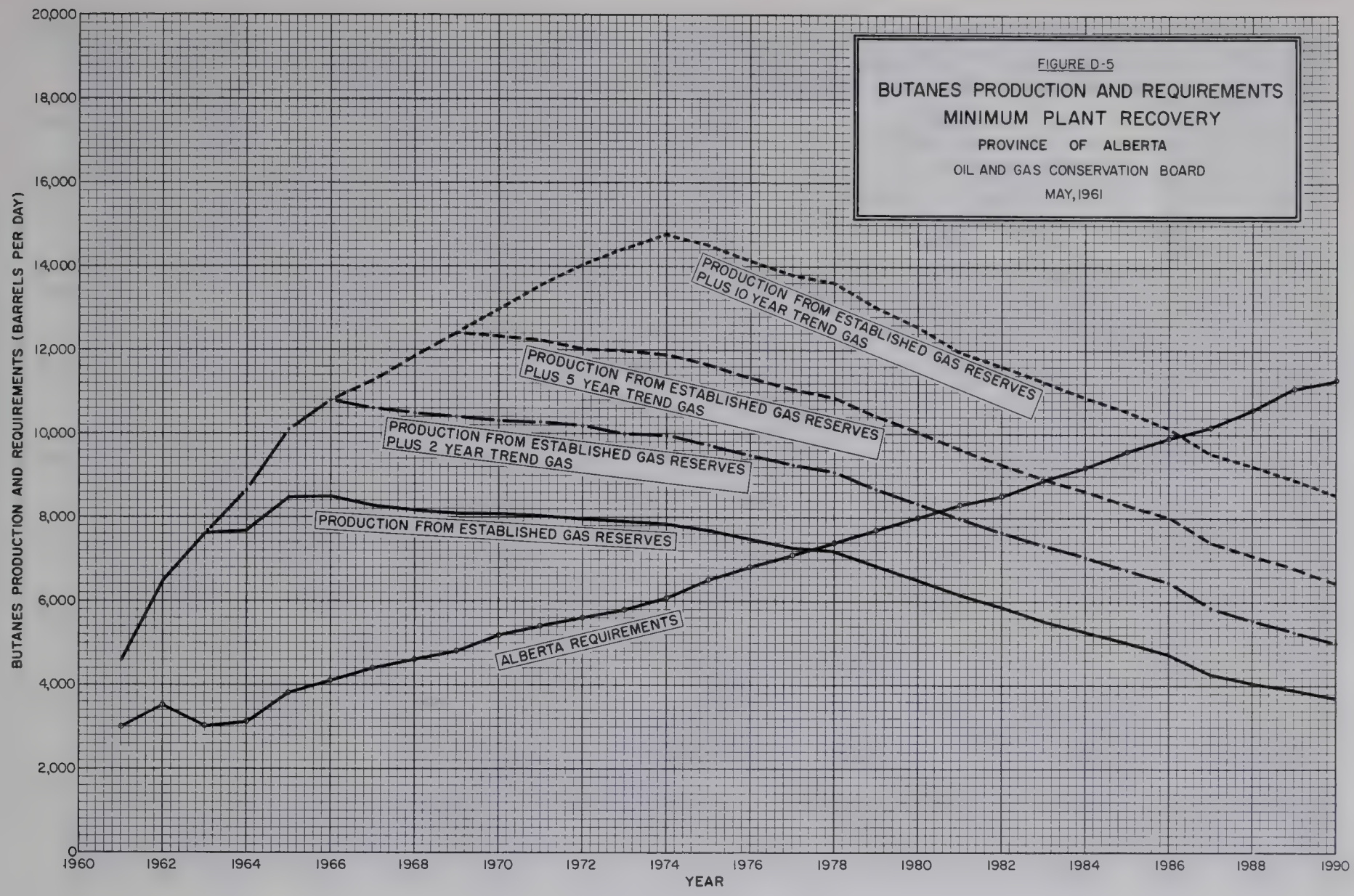


FIGURE D-6

BUTANES PRODUCTION AND REQUIREMENTS
MAXIMUM PLANT RECOVERY

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

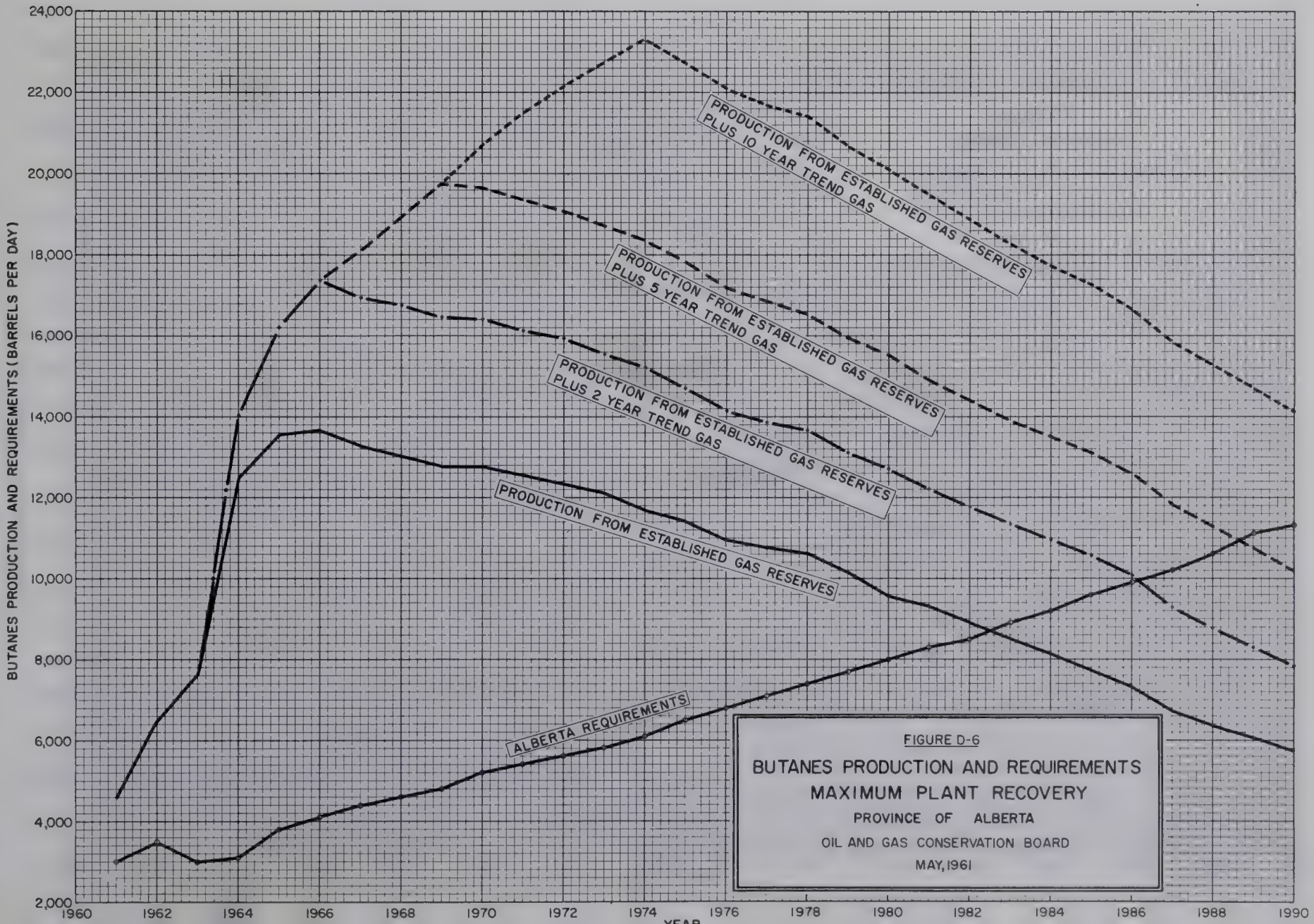


FIGURE D-7

BUTANES SURPLUS
MINIMUM PLANT RECOVERY

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

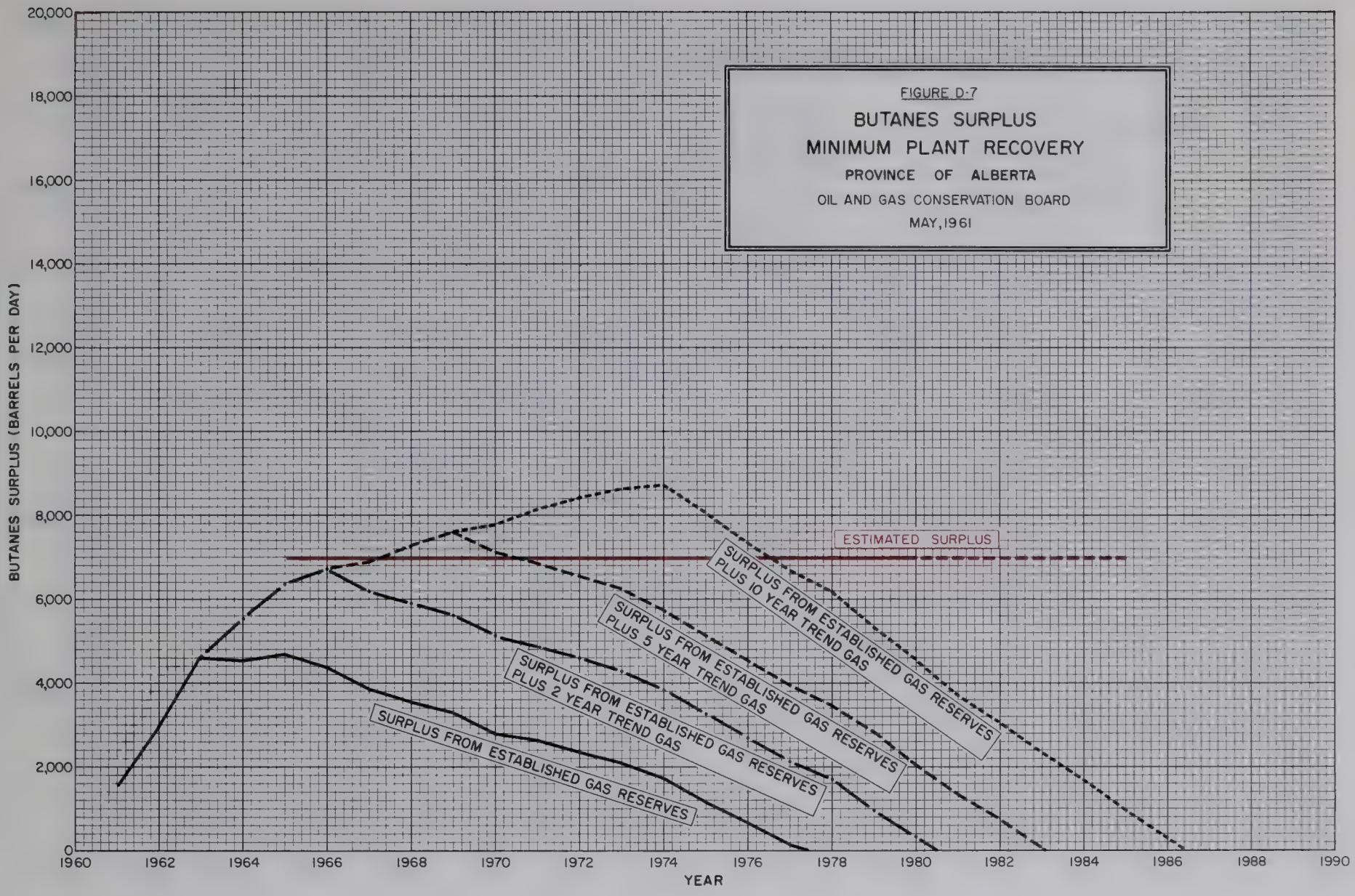


FIGURE D-8

BUTANES SURPLUS
MAXIMUM PLANT RECOVERY

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

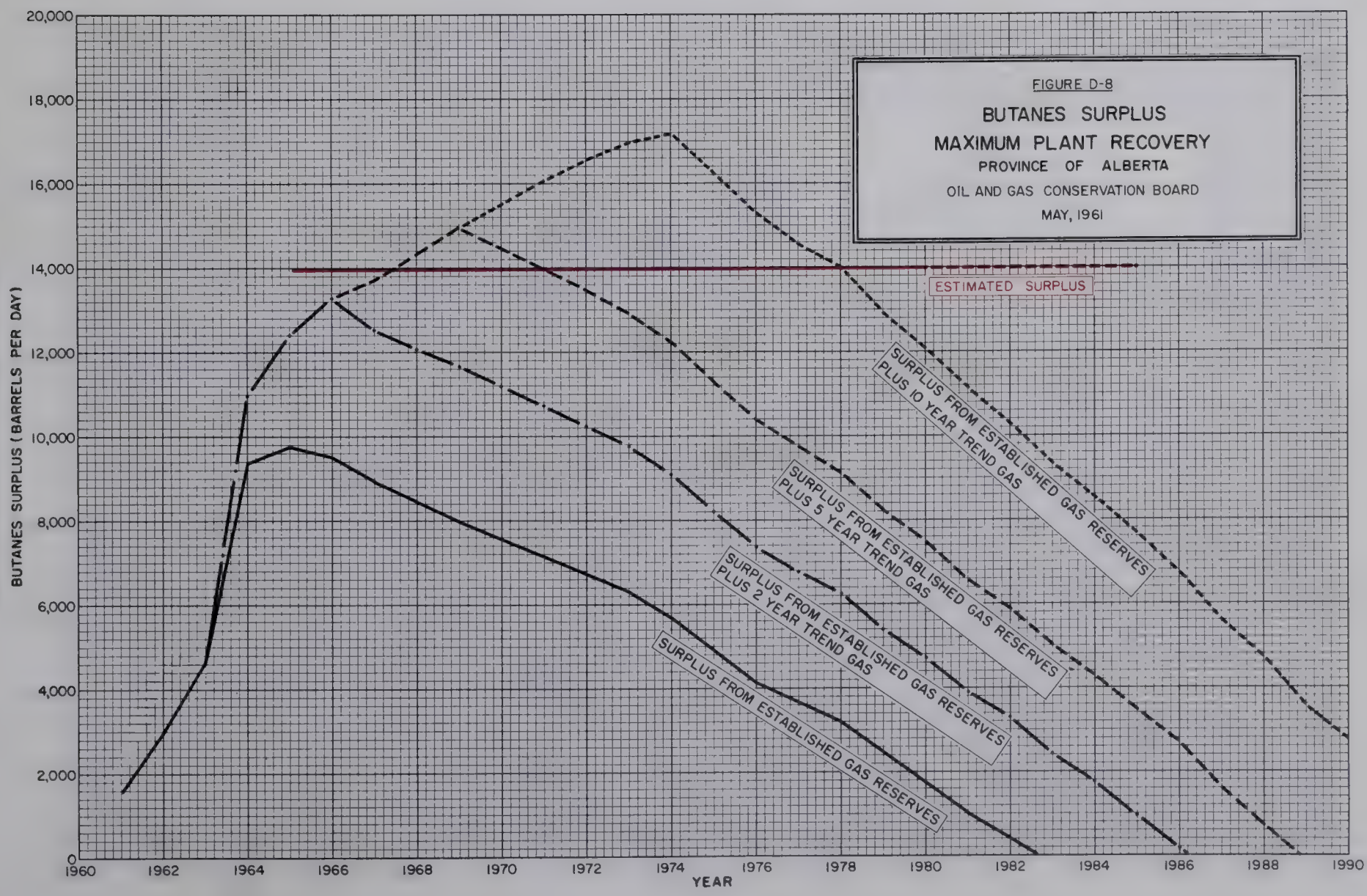


FIGURE D-9

PRODUCTION AND REQUIREMENTS
PENTANES PLUS

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961

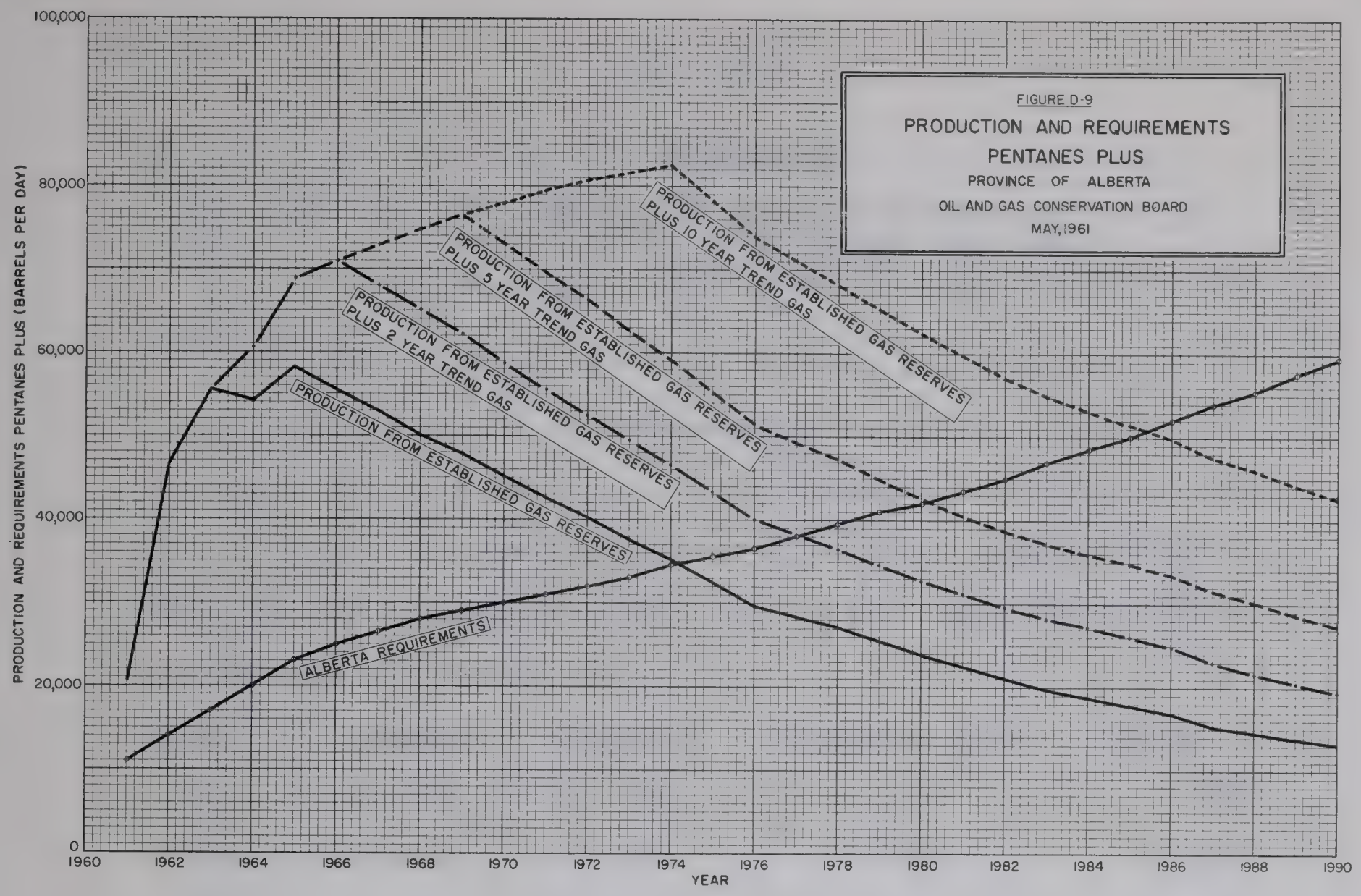


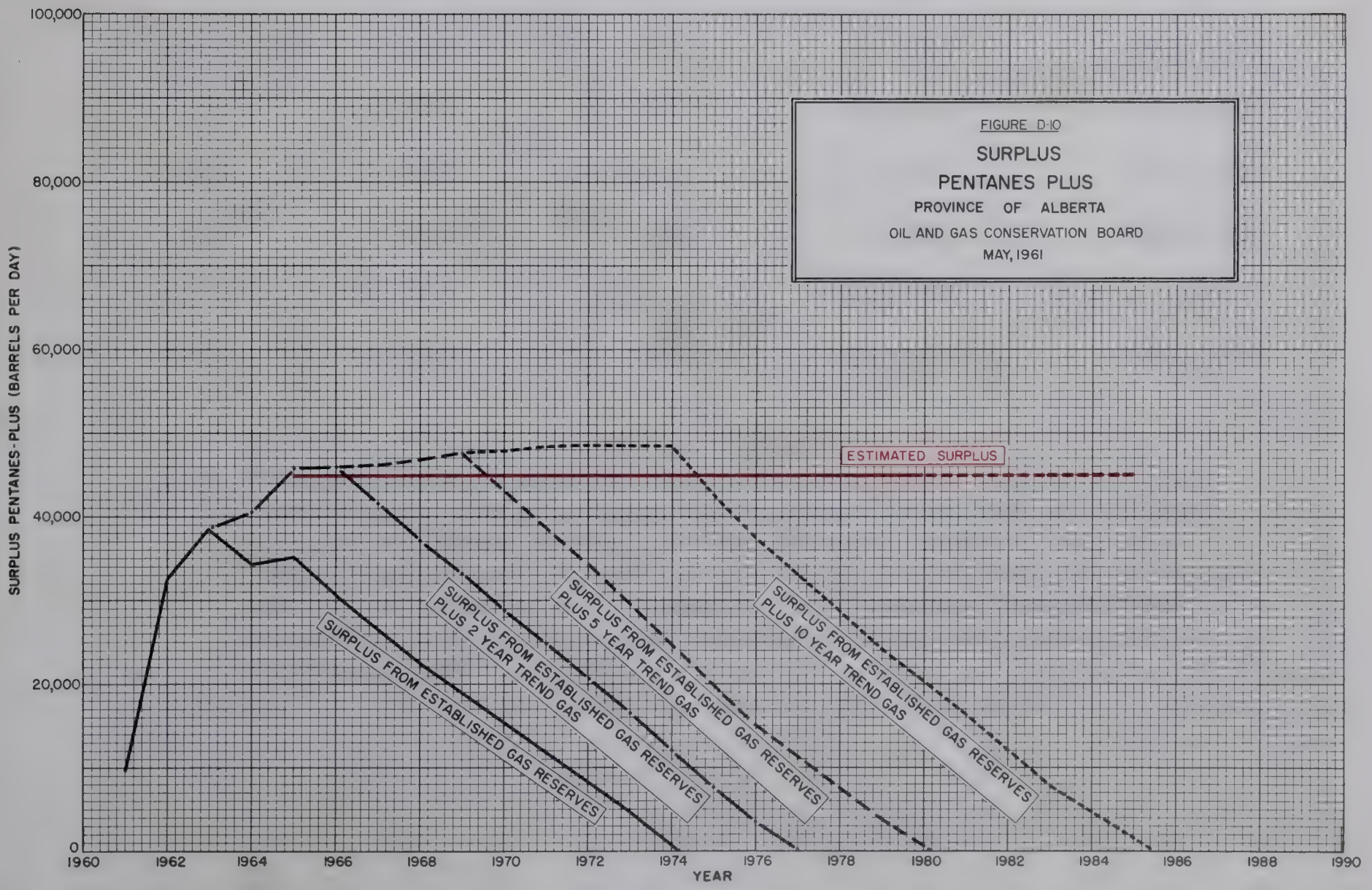
FIGURE D-10

SURPLUS
PENTANES PLUS

PROVINCE OF ALBERTA

OIL AND GAS CONSERVATION BOARD

MAY, 1961



APPENDIX E

THE QUANTITY OF SURPLUS NATURAL GAS LIQUIDS WHICH MIGHT BECOME AVAILABLE TO FOOTHILLS

Mr. Van Wielingen of J. C. Sproule and Associates, testifying on behalf of the Westalta-Foothills group at the original Westalta hearing and the original Foothills hearing, stated that his firm had forecast the total volumes(1) of natural gas liquids available for removal from the Province in barrels per day to be:

Year	Propane	Butanes	Pentanes Plus	Total
1962	10,950	13,900	42,950	67,800
1963	12,850	16,400	50,350	79,600
1964	14,600	18,600	54,700	87,900
1965	15,900	18,400	58,800	93,100
1966	17,850	20,650	64,500	103,000
1967	19,400	22,400	68,900	110,700
1968	21,450	24,450	71,500	117,400
1969	23,400	26,300	74,200	123,900
1970	25,700	28,550	76,850	131,100
1971	28,150	31,050	81,100	140,300

(1) The propane, butanes and pentanes plus shown in this table were obtained by difference from the available liquid volumes shown in the Sproule report and the requirement presented in the Harries report with very minor adjustments to make these figures compatible with the total figures presented and used in other Foothills submissions.

Based on its own studies (Appendices A, B, C and D), the Board considers the above volumes to be unrealistic. The following table summarizes the Board's estimate of the maximum surplus natural gas liquids which would be available under conditions of increased economic incentive. It will be recalled that in Appendix A production estimates, in barrels per day, were prepared on the basis of existing economic conditions and on the basis of increased economic incentive, which might be represented by a scheme such as Foothills'.

Year	Propane	Butanes	Pentanes Plus	Total
1962	925	2,960	32,500	36,385
1963	2,100	4,600	38,500	45,200
1964	6,900	10,900	40,500	58,300
1965	8,400	12,400	46,000	66,800
1966	8,800	13,200	46,000	68,000
1967	8,800	13,200	46,000	68,000
1968	8,800	13,200	46,000	68,000
1969	8,800	13,200	46,000	68,000
1970	8,800	13,200	46,000	68,000
1971	8,800	13,200	46,000	68,000

The Board does not consider it reasonable to assume that all of these surpluses would be available to Foothills for transportation to Chicago. At the present time all natural gas liquid products being marketed in areas considerably removed from this Province are moved by existing transportation

means. The Board believes that at least some of these shipments would continue even though the Foothills scheme were to be constructed. However, in order to give the scheme fair consideration, the Board has estimated these extra-provincial shipments on an extremely minimum basis. Details with regard to the Board's assessment of these possible movements are provided below.

PROPANE AND BUTANES

The Board has not conducted a detailed analysis of the volumes of propane and butanes which will be marketed beyond the fringe areas described in Appendix C, even though the Foothills scheme were to become a reality. However, it is satisfied that such shipments will occur and has allowed for them as follows:

(a) Propane: 850 barrels per day in 1962, increasing to 1,600 barrels per day by 1964, and held at this level to 1971.

(b) Butanes: 700 barrels per day in 1962, increasing to 1,000 barrels per day in 1964 and held at this level to 1971.

A breakdown of the Board's estimates on an annual basis is presented in Table E-1.

PENTANES PLUS

The Board also believes that some pentanes plus will be moved to market by means other than the Westalta-Foothills-

Dakota-Eastern system, regardless of whether the Foothills project is given approval. The Board realizes that it is extremely difficult to forecast the magnitude of such shipments. But recognizing that pentanes plus are presently being transported through the Interprovincial and Trans Mountain systems, and that refiners along the pipe line routes will find this product a desirable feedstock, the Board has estimated that in 1962 a minimum of 6,000 barrels per day would be transported by these means and that by 1971 this volume would increase to 16,000 barrels per day. It should be noted that these volumes are based on the approval of the Foothills scheme and should this not occur then substantially larger volumes would move through these pipe lines.

In the report to the Department of Mines and Minerals on the pipe line permit applications referred to in this report, the Board is recommending approval of the Hudson's Bay scheme. This application proposed to gather pentanes plus produced in the Pincher Creek-Waterton-Lookout Butte area and transport them to areas in the United States south of this Province. The Board also believes it only realistic to consider the possibility of these products not being available to Foothills for shipment to Chicago. The Board estimates that in 1961 approximately 8,500 barrels per day will be absorbed by these markets and that by 1971 this volume will increase to approximately 13,400

barrels per day. Details of the estimated annual volumes are provided in Table E-1.

SURPLUS NATURAL GAS LIQUIDS AVAILABLE TO FOOTHILLS

Based upon the estimates referred to above, the Board has forecast the volumes of propane, butanes and pentanes plus which would be available to Foothills for shipment to Chicago. It should be noted that this forecast assumes that all of the surplus products could be purchased by Tuloma or others wishing to use the facilities of the Foothills scheme. The forecast is also based on the assumption that economic conditions would be such as to provide sufficient incentive for operators to recover maximum volumes of propane and butanes. Details of this forecast are provided in Table E-2. It will be noted that the volumes of natural gas liquids available to Foothills, after allowing for minimum movement through existing transportation means, increases from approximately 28,800 barrels per day in 1962 to a peak of 56,400 barrels per day by 1966 and then decreases to some 49,400 barrels per day by 1971. If allowance is made for the volumes of pentanes plus that the Board estimates would be moved if the proposed Hudson's Bay scheme were approved, the surplus is reduced to 20,300 barrels per day in 1962 and some 43,800 barrels per day in 1966. These volumes are considerably less than those used by the applicant in evaluating and designing the pipe line

system.

The Board has also compared the proportion of each product to the total stream in each of the years 1962, 1966 and 1971. The composition in per cent would be as follows:

Year	Propane	Butanes	Pentanes Plus
1962	0.4	11.1	88.5
1966	16.4	27.9	55.7
1971	20.0	33.9	46.1

The above data can be compared with the 16.2 per cent propane, 20.6 per cent butanes and 63.2 per cent pentanes plus stream proposed by the applicant. In 1962 the pentanes plus proportion is actually higher based upon the Board's estimates of surplus volumes but by 1971 is considerably less than the estimate prepared by the applicant.

TABLE E-1

OIL AND GAS CONSERVATION BOARD

ESTIMATED MOVEMENT OF NATURAL GAS LIQUIDS BY EXISTING TRANSPORTATION MEANS(1) AND THE PROPOSED HUDSON'S BAY PIPE LINE

(Barrels per day)

	Existing Transportation Means					
Year	Propane	Butanes	Pentanes Plus	Total	Pentanes Plus Hudson's Bay Pipe Line	Total
1962	850	700	6,000	7,550	8,500	16,050
1963	1,200	850	6,000	8,050	9,900	17,950
1964	1,600	1,000	7,000	9,600	10,000	19,600
1965	1,600	1,000	8,000	10,600	12,600	23,200
1966	1,600	1,000	9,000	11,600	12,600	24,200
1967	1,600	1,000	10,000	12,600	12,800	25,400
1968	1,600	1,000	12,000	14,600	13,000	27,600
1969	1,600	1,000	13,000	15,600	13,200	28,800
1970	1,600	1,000	14,000	16,600	13,300	29,900
1971	1,600	1,000	16,000	18,600	13,400	32,000

(1) Truck, tank car, Trans Mountain pipe line and Interprovincial pipe line

TABLE E-2

OIL AND GAS CONSERVATION BOARD

ESTIMATED SURPLUS NATURAL GAS LIQUIDS AVAILABLE TO FOOTHILLS

(Barrels per day)

Year	Total Surplus	Movement by Existing Transportation means	Total Surplus less Movement by Existing Means	Movement by Hudson's Bay Pipe Line	Net Surplus Available to Foothills
1962	36,385	7,550	28,835	8,500	20,335
1963	45,200	8,050	37,150	9,900	27,250
1964	58,300	9,600	48,700	10,000	38,700
1965	66,800	10,600	56,200	12,600	43,600
1966	68,000	11,600	56,400	12,600	43,800
1967	68,000	12,600	55,400	12,800	42,600
1968	68,000	14,600	53,400	13,000	40,400
1969	68,000	15,600	52,400	13,200	39,200
1970	68,000	16,600	51,400	13,300	38,100
1971	68,000	18,600	49,400	13,400	36,000

APPENDIX F

ECONOMIC FEASIBILITY OF THE APPLICANT'S SCHEME

OWNERSHIP AND CONTRACTS

At both the original and reopened Westalta and Foothills hearings the applicant and its associates emphasized that they did not own, or have purchase contracts, for any natural gas liquids which they proposed to transport. They stated further that they proposed to operate as common carriers of natural gas liquids and would therefore move all tendered liquids.

The only signed contract in the possession of Westalta and Foothills at present is their agreement with Standard to move product purchased by Tuloma; neither Westalta nor Foothills have contracts to move products owned by any other party. Tuloma, however, has been unsuccessful in its efforts to sign purchase contracts with Alberta natural gas liquid producers. Westalta and Foothills are therefore in the position where they have a contract to move natural gas liquids with a company which has no product to move and has signed no contracts to purchase product.

Tuloma, though not in possession of signed purchase contracts, has nevertheless distributed a proposed contract to several producers of natural gas liquids in Alberta. The prices offered by this contract for specification product in dollars per barrel were

propane	1.05
butanes	1.40
pentanes plus to 190°F	2.10
190°F to 360°F	2.90
360°F and heavier	2.10

TARIFFS PROPOSED BY THE APPLICANT

Testifying on behalf of the applicant at the reopened Foothills-Westalta hearing, Mr. Booth of Pembina Pipe Lines Limited stated that the Westalta-Foothills-Dakota-Eastern system, Figure F-1 and F-2, tariffs for moving natural gas liquids from Calgary to the Chicago area have been estimated to be

(a) 40 cents per barrel for the first five and one-half years of operation, during which time throughput volumes are expected to increase from a minimum of 50,000 barrels per day to approximately 107,000 barrels per day, and

(b) 37 cents per barrel thereafter until the fifteenth year, during which time the throughput volumes are expected to increase to 160,000 barrels per day.

Testifying on behalf of Foothills, at the original hearing, Mr. Matheny stated that the cost of separating the components of the commingled stream at Chicago had been

estimated to be

(a) 17 cents per barrel for the first five years of operation, and

(b) 16 cents per barrel by the tenth year.

Both the transportation and fractionation costs were based on

(a) a return of

(i) 7.75 per cent for the throughput volumes of 100,000 barrels per day or less,

(ii) 8.25 per cent for throughput volumes of greater than 100,000 but less than 130,000 barrels per day, and

(iii) 8.75 per cent for throughput volumes greater than 130,000 barrels per day,

(b) a straight line depreciation of

(i) 3.4 per cent on the Foothills and Dakota-Eastern lines,

(ii) 4 per cent on the Westalta main line, and

(iii) 3.4 per cent on the fractionation plant,

(c) a composite average capital cost allowance of 7 per cent per year applied to the diminishing balance for income tax calculations,

(d) 85 per cent debted financing at 6 per cent interest, and 15 per cent equity financing.

In addition to the Westalta-Foothills-Dakota-Eastern tariffs, Mr. Booth, at the reopened Westalta-Foothills hearing, also presented the following estimate of tariffs which would be levied against the liquids by the Westalta gathering system (Figure F-1):

(a) 20 cents per barrel for the first two and one-half years of operation, during which time the throughput volumes are expected to increase from a first year volume of 30,000 to approximately 66,500 barrels per day,

(b) 12 cents per barrel for the next five years of operation, as volumes increase from 66,500 to 127,000 barrels per day, and

(c) 10½ cents decreasing to 9½ cents per barrel over the next three and one-half years of operation, during which time the throughput volumes are expected to increase from 127,000 to 160,000 barrels per day.

Using the Westalta and Foothills tariffs presented by Mr. Booth, the fractionation costs presented by Mr. Matheny and the plant gate prices offered by Tuloma, the Board's calculations indicate that the initial value of the products in the Chicago area would be

	Propane		Butanes		Pentanes Plus	
	$/bbl	¢/US Gal	$/bbl	¢/US Gal	$/bbl	¢/US Gal
Value at plant gate	1.05	2.50	1.40	3.34	2.46*	5.86*
Gathering Costs (Westalta)	0.20	0.48	0.20	0.48	0.20	0.48
Transmission Cost (Westalta-Foothills-Dakota-Eastern)	0.40	0.95	0.40	0.95	0.40	0.95
Import Duty	0.10	0.24	0.10	0.24	0.10	0.24
Fractionation Cost	0.17	0.40	0.17	0.40	0.17	0.41
	1.92	4.57	2.27	5.41	3.33	7.94

* Based on a stream which is

30 per cent pentanes to 190°F
45 per cent pentanes from 190°F to 360°F
25 per cent pentanes of 360°F and heavier.

TARIFFS BASED ON BOARD ESTIMATED SURPLUS VOLUMES

Using the Board's estimate of the natural gas liquid volumes which will be available for extraprovincial markets as outlined in Appendix E, the facilities proposed and the cost data submitted by the applicant, the Board, based on the applicant's method of estimating tariffs, has estimated that the tariffs, excluding gathering and fractionation costs, required to move the different possible volumes of liquids available to the applicant from Calgary to the Chicago area to be:

	5-year average ¢/bbl	10th year ¢/bbl
Total Surplus under increased economic incentive	66	49
Total Surplus less volumes moved by existing transportation means	80	68
Total Surplus less volumes moved by existing transportation means and by the proposed Hudson's Bay scheme	105	93
Tariffs proposed by the applicant	40	37

ECONOMIC FEASIBILITY AND FINANCIBILITY

Financial Details

For the purposes of financing, the facilities provided under the Westalta-Foothills-Dakota-Eastern scheme have been divided into four sections:

(a) the Westalta main line (232 miles) which extends from a point immediately east of Calgary to a point near the International border in the vicinity of the Alberta-Saskatchewan border,

(b) the Foothills line (approximately one mile) located at the International border at the terminal of the Westalta main line,

(c) the Dakota-Eastern line (1,244 miles) which extends from the International border to the Chicago area, and

(d) the fractionation plant at the terminus of the Dakota-Eastern line.

The total capital investment required for the project has been estimated by the applicant to be:

Westalta	Main line (Calgary to the Border)	$14,076,000.00
	Line fill and working capital	696,000.00
	Financing costs and expenses	309,000.00
		$15,081,000.00
Foothills* and Dakota-Eastern	Export line	$67,540,000.00
	Line fill and working capital	3,794,000.00
	Financing costs and expenses	1,400,000.00
		$72,734,000.00
Fractionating Plant		$12,692,000.00
	Working capital	484,000.00
	Financing costs and expenses	323,000.00
		$13,499,000.00
	Total capital required	$101,314,000.00

* The applicant's submission did not give a separate breakdown of the estimated cost of the Foothills section of the line but a witness for the applicant under cross-examination at the October hearing stated it would be about $160,000.00.

At the reopened Westalta-Foothills hearing Mr. N. J. Stewart of Standard and Mr. Booth of Pembina, testifying on

behalf of Foothills, stated that as far as possible, the four companies involved in the overall project would be financed in the following manner:

(a) 60 per cent by the sale of first mortgage bonds bearing interest at the rate of 6 per cent per year and maturing in twenty years,

(b) 25 per cent by the issuance of debentures bearing interest at the rate of 6 per cent per year for a term of twenty-one years, and

(c) 15 per cent by the sale of common stock.

Mr. Stewart further stated that the responsibility for obtaining necessary financing had been designated in the following manner:

(a) for Westalta gathering system, to Pembina,

(b) for Westalta main line, to Pembina and Standard, with Standard being primarily responsible,

(c) for Foothills, to Pembina and Standard, with Standard being primarily responsible,

(d) for Dakota-Eastern, to Standard,

(e) for fractionation company, to Standard.

During the original Westalta and Foothills hearings, Mr. J. M. McConnell of Nesbitt, Thomson and Company Limited, with headquarters in Montreal, and Mr. A. E. Borneman of Kidder, Peabody and Company, 17 Wall Street, New York, testified on behalf of Westalta and the Foothills-Dakota-Eastern-fractionating company group respectively concerning the financibility

of the project.

Mr. McConnell, under cross-examination, stated that his firm believes that the overall Westalta system (gathering system and main line) would be financible on the basis of the evidence presented at that hearing, if the export line became a reality, but that the Westalta main line would not be financible if there were no export line. He further stated, however, that Nesbitt, Thomson and Company Limited had not, at the time of the hearing, completed a detailed independent examination of the entire Westalta system and that if the Westalta gathering system were used for "transporting local hydrocarbons within the Province" Nesbitt Thomson would

(a) require new statements from the consultants to redetermine the economics of the system, and

(b) assume that any segment of the gathering system which was not economic would not be built and would therefore not require financing.

During direct testimony Mr. Borneman stated that his firm believes that the project proposed by Foothills-Dakota-Eastern and the fractionation company can be financed on the basis of the evidence submitted at the hearing, if the necessary governmental approvals are obtained. He further stated that his firm considers these approvals to be essential to the existence of the project, and that his firm feels that the project can be financed without the existence of throughput or purchase contracts if these approvals are

obtained.

Neither witness, however, discussed the effect which reduced ultimate throughput volumes would have on the financibility of the overall project.

ECONOMIC FEASIBILITY

In both the Westalta and Foothills hearings, evidence and examination of the applicant's witnesses made it clear that the economic feasibility of the proposed scheme would depend primarily on the volumes of natural gas liquids consigned for transportation to Chicago. At separate hearings Mr. Scott and Mr. Stewart advised the Board that the applicant would have to be assured of a minimum initial throughput and a rapid build-up in volumes during the early years of the project before construction or financing would be feasible. The minimum volume was assessed at 50,000 barrels per day and the applicant estimated that throughput would increase to 160,000 barrels per day by the fifteenth year.

The Board's forecast of the maximum volume of surplus natural gas liquids available to Foothills (Appendix E) is considerably less than the above volumes. The Board's estimate, increasing from approximately 20,000 barrels per day in 1962 to a peak of approximately 44,000 barrels per day in 1966, does not reach even the minimum volume required by the applicant. If the quantities which the forecast

anticipates will be transported through the proposed Hudson's Bay pipe line were added to the above surplus volumes, a peak of approximately 56,000 barrels per day would be achieved in 1965 and 1966. While this is in excess of the minimum requirement specified by the applicant, the Board's estimate does not provide any hope for future growth.

Usually the question of transportation or purchase contracts is of importance in evaluating the economic feasibility of a pipe line application. In this case a transportation contract does exist but has limited significance due to a lack of purchase contracts. However, in view of the fact that in the Board's opinion insufficient surplus volumes exist to justify the scheme, this particular deficiency is less important.

Having regard to the applicant's testimony relating to the volumes of throughput required to make the scheme feasible and the studies conducted by the Board regarding the surplus quantities that would be available, the Board can only conclude that the scheme is neither economically feasible nor financible.

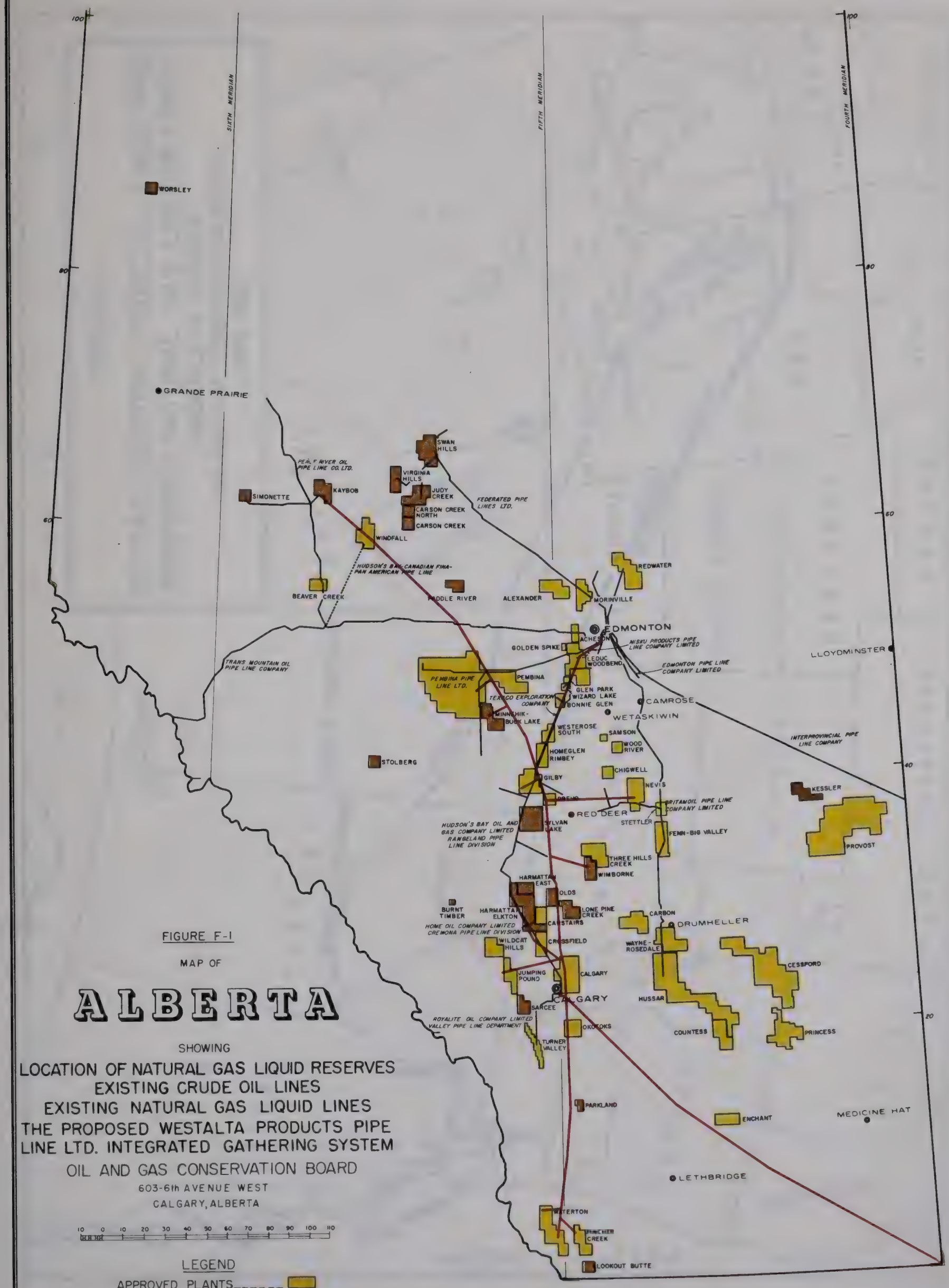


FIGURE F-1

MAP OF

ALBERTA

SHOWING

LOCATION OF NATURAL GAS LIQUID RESERVES
EXISTING CRUDE OIL LINES
EXISTING NATURAL GAS LIQUID LINES
THE PROPOSED WESTALTA PRODUCTS PIPE LINE LTD. INTEGRATED GATHERING SYSTEM

OIL AND GAS CONSERVATION BOARD
603-6th AVENUE WEST
CALGARY, ALBERTA

10 0 10 20 30 40 50 60 70 80 90 100 110

LEGEND

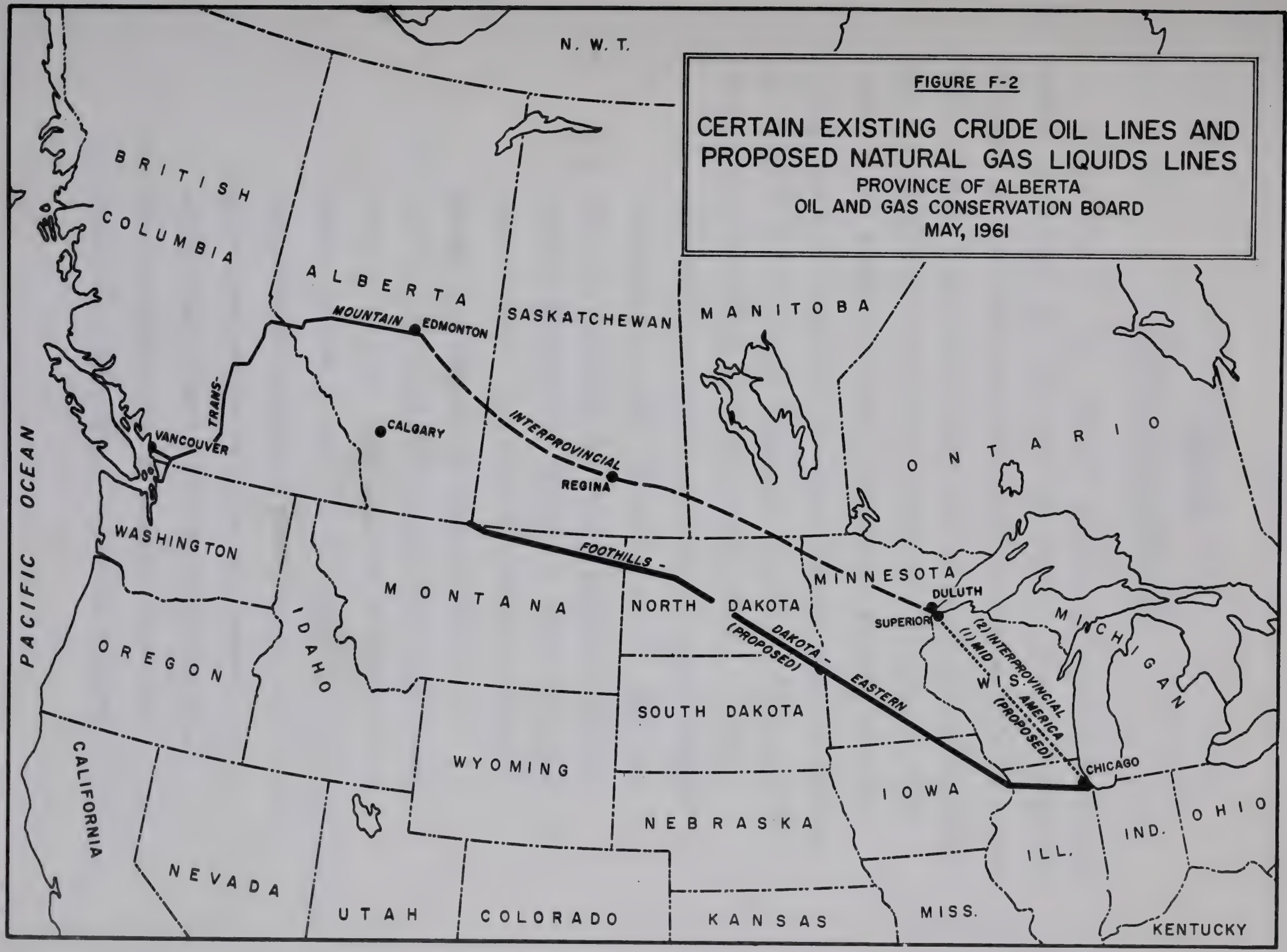
APPROVED PLANTS
FUTURE PLANTS
WESTALTA PRODUCTS PIPE LINE LTD.

MAY, 1961

FIGURE F-2

CERTAIN EXISTING CRUDE OIL LINES AND PROPOSED NATURAL GAS LIQUIDS LINES

PROVINCE OF ALBERTA
OIL AND GAS CONSERVATION BOARD
MAY, 1961



APPENDIX G

GENERAL CONSIDERATIONS

Objections to the Foothills proposal to move a commingled stream of natural gas liquids from Alberta to the Chicago area by means of a sixteen-inch line originating near Calgary were registered at both the original and reopened Foothills hearings by interveners mentioned in the Introduction to this report. The majority of the interveners agreed that the Chicago area would afford an outlet for the surplus natural gas liquids which will be produced in Alberta but opposed the Foothills proposal on the following major issues:

(a) the contention that the surplus liquid volumes as presented by Dr. Sproule are too high and that the proposed Westalta-Foothills-Dakota-Eastern tariffs are therefore lower than the tariffs which would be required to move the actual volumes to the Chicago area,

(b) the contention that existing oil lines, both those within the Province and interprovincial lines, should be used to the limit of their capacity before the construction of pipe lines to be used exclusively for the movement of natural gas liquids should be undertaken,

(c) the contention that a blanket tariff for a gathering system would be unfair to some

fields; each segment of a gathering system should pay its own way and uneconomic sections of a system should not be subsidized by economic sections,

(d) the contention that the injection of large volumes of Alberta pentanes plus into a single United States market at this time could have a detrimental effect on the overall marketing of Alberta crude oil and that the United States market for condensate should be built up on step-wise basis from a modest beginning of approximately 10,000 barrels per day,

(e) the contention that no major pipe line in Canada or the United States has ever been financed without throughput agreements or purchase contracts and that there is no reason to believe that the Foothills project could be financed without such agreements or contracts,

(f) the proposed Tuloma gas purchasing contract.

ALTERNATE MEANS OF REMOVING NATURAL GAS LIQUIDS FROM ALBERTA

Several of the interveners proposed alternate means of moving Alberta natural gas liquids to Canadian and United States markets at the Westalta, Foothills and other hearings. These alternate means are presented below under the classifications of "Removal by Pipe Line" and "Removal by Truck

and Tank Car".

Removal by Pipe Line

1. Interprovincial - Mid-America

Hydrocarbons and Provincial Products jointly proposed a plan whereby surplus butanes and pentanes plus would be transported from Edmonton to Superior, Wisconsin, by Interprovincial and from Superior to the Chicago area by means of a line which would be constructed by Mid-America Pipeline Company. The route of the line proposed by Mid-America is shown in Figure F-2. Mr. D. A. Roach of Mid-America appearing as a witness on September 21, 1960, stated that his company was prepared to build 441 miles of 10 3/4-inch common carrier line from Superior to Chicago with initial and ultimate capacities of 26,100 and 55,300 barrels per day of product, having a Reid Vapor Pressure of 35 pounds per square inch or less. The total cost of the proposed Mid-America line was estimated by Mr. Roach to be $20,868,000. No estimated cost of fractionation or additional storage along the Interprovincial line were submitted at the hearing, but from evidence submitted at subsequent hearings the Board estimates that additional storage along the Interprovincial

line would cost approximately $1,900,000 and that fractionation at Chicago would cost approximately 7 cents per barrel.

Mr. Roach further stated that the tariff for this system, based on posted Interprovincial and estimated ten-year average Mid-America tariffs would be

Origin	Interprovincial $/bbl	Mid-America $/bbl	Total $/bbl
Edmonton	0.37	0.28	0.65
Hardisty	0.35	0.28	0.63

with the Mid-America estimate based on

(a) a return on the depreciated rate base ranging from 4.2 per cent in 1962 to 13.0 per cent in 1971,

(b) a straight line financial depreciation of 4 per cent per year,

(c) depreciation for income tax purposes calculated at 6 per cent of the declining balance,

(d) financing of

(i) 70 per cent debt financing at 6 per cent interest (first mortgage bonds),

(ii) 15 per cent debt financing at 6½ per cent interest (subordinate debentures),

(iii) 15 per cent equity,

(e) throughput volumes increasing from 22,200 to 47,000 barrels per day from 1962 to 1970.

This method of removing natural gas liquids from the Province could be used to transport product delivered to Edmonton or Hardisty by the following pipe line systems:

(a) Provincial Products,

(b) Hydrocarbons,

(c) Britamoil (Rimbey to Edmonton portion),

(d) Westalta (Rimbey to Edmonton portion),

(e) existing oil lines.

Like the Foothills project this method of moving natural gas liquids to the Chicago area would be dependent mainly upon condensate for the throughput volumes required to make it economically feasible. This scheme differs from the Foothills project, however, in that initially at least, it does not provide a means of transportation for propane. The supporters of the Mid-America project gave no evidence related to possible purchasers in the Chicago area.

2. Interprovincial

In a submission presented at the reopened Foothills hearing Mr. Lynch of Canadian Bechtel

Limited, on behalf of Interprovincial, and Mr. Waldon of Interprovincial, stated that Interprovincial is prepared to construct 420 miles of sixteen-inch natural gas liquid line from Superior to the Chicago area with initial and ultimate capacities of 50,000 and 160,000 barrels per day of product with a Reid Vapor Pressure of 35 pounds per square inch or less. The route of this line is shown on Figure F-2. The initial cost of the extension and the additional storage facilities which would be required along the existing Interprovincial line were estimated by Interprovincial to be $23,500,000 and $1,920,000 respectively. No estimate for fractionation costs were included in the submission.

Mr. Lynch further stated that before this proposed extension would be built, reasonable assurance would have to be received by Interprovincial that a minimum daily average throughput volume of 20,000 barrels per day would be realized and that the tariffs which Interprovincial would charge for moving the product from Edmonton to the Chicago area would be $0.55 per barrel for throughputs of 20,000 barrels per day and $0.44 per barrel for throughputs of 50,000 barrels per day. Tariffs for intermediate

volumes would decline as the volumes increased and volumes greater than 50,000 barrels per day would be favoured with additional tariff reductions.

No details of the tariff calculations were submitted by Interprovincial. However, during the reopened Foothills hearing Mr. Burgess, counsel for Interprovincial, stated that the 55 cent tariff is a competitive tariff. He further stated that it has been firmly established by the Supreme Court of Canada that a pipe line company operating in Canada is entitled to quote competitive tariffs, and that Interprovincial was not prepared to reveal what portion of the tariff was for the Edmonton to Superior line and what portion was for the proposed Superior to the Chicago area line.

This scheme also could be used for the removal of product delivered to Interprovincial at Edmonton or Hardisty by Provincial Products, Hydrocarbons, Britamoil, Westalta and existing oil lines.

Like the Interprovincial-Mid-America scheme, Interprovincial's proposal is mainly dependent on condensate volumes for economic tariffs and would not initially supply a means of transportation for propane. No evidence related to possible purchasers in the Chicago area was presented in support of this plan.

Mr. Lynch contended that a movement of a 100,000 barrel batch of blended natural gasoline (35,000 barrels), and Pembina crude oil (65,000 barrels), having a 50° API gravity and a 12 pound Reid Vapor Pressure, from Edmonton to Bay City, Michigan, and Sarnia, Ontario, through existing facilities has demonstrated Interprovincial's ability to transport natural gas liquids. This contention was challenged by the applicant.

Although the movement did not take place until after the hearings, Interprovincial in April, 1961, did transport approximately 50,000 barrels of condensate from Edmonton to Wrenshall, Minnesota, in batch form. The posted tariff at the time of the condensate movement was 37 cents per barrel.

3. Hudson's Bay

Hudson's Bay, in conjunction with the proposed Aurora Pipe Line Company and The Continental Pipe Line Company, proposes to deliver condensate from the Pincher Creek, Waterton and Lookout Butte fields to Byron, Wyoming, and intermediate points, and possibly beyond Byron by means of the Platte Pipe Line System. At the hearing of the Hudson's Bay application for a permit to construct approximately eleven miles of 4½-inch line from Waterton

to Pincher Creek and thirty miles of a 8 5/8-inch line from Pincher Creek to the International border near Carway, witnesses for Hudson's Bay stated that they believed that the United States market for Alberta condensate must be developed on a step-wise basis and that the parent company, Continental Oil Company, believes that it can now market approximately 10,000 barrels of pentanes plus per day in the Byron area.

The pipe line system proposed by Hudson's Bay is designed as one continuous line from Pincher Creek to Cut Bank, Montana, and would cost an estimated $1,598,600. The line would have an ultimate capacity of 31,000 barrels per day with two 500 horsepower pumping units (one on standby) operating at a pressure of 1,200 pounds per square inch. The application was for the transportation of only pentanes plus.

No detailed tariff calculations were submitted for the Hudson's Bay and associated pipe line systems but Mr. Lloyd, testifying on behalf of Hudson's Bay, stated that the combined tariff required to make the Hudson's Bay and Aurora lines feasible has been estimated to be:

	5-year average ¢/barrel	10-year average ¢/barrel
Basic case	5.06 - 6.50	5.16 - 6.50
Prospective case	3.25 - 4.74	3.03 - 4.23

The basic case is a minimum condition and uses only production from proven and probable reserves which have already been discovered, making no allowance for additional volumes from future discoveries. The prospective case includes liquid volumes anticipated from future discoveries in the area served by the pipe line.

The bases for these tariffs are:

(a) throughput volumes,

(i) for the basic case, ranging from 11,430 barrels per day in 1962 to 16,190 barrels per day in 1965 and decreasing to 11,120 barrels per day in 1971,

(ii) for the prospective case, increasing from 11,430 barrels per day in 1961 to 22,120 barrels per day in 1971,

(b) a return,

(i) for minimum tariffs, of 2 per cent on the residual investment after interest,

(ii) for maximum tariffs, of 5 per cent on the residual investment after interest,

(c) depreciation based on a unit of throughput over the estimated economic life of the proven and probable reserves (25 years),

(d) a composite tax depreciation rate of 7 per cent on a declining balance for income tax calculations,

(e) 75 per cent debt financing at 6 per cent interest (first mortgage bonds, maturing in 20 years) and 25 per cent equity, with all capital to come from the parent company.

Mr. Lloyd further stated that the tariff for moving product to the Chicago area by this route would be similar to that for the Foothills system.

Under the Hudson's Bay proposed scheme the condensate from the Pincher Creek, Waterton and Lookout Butte fields would be removed from the Province and the condensate requirements of the Calgary refineries would be supplied from the fields adjacent to Calgary. If implemented, however, this scheme would be of no assistance in moving to a market the natural gas liquids from the central part of the Province and some means of transporting surplus product from this area would still be required.

Although intended initially as a means of transporting only condensate, this system would be a possible mode of transporting propane and butanes in the future. Here too, however, the condensate volumes would mainly determine the tariff economics and additional facilities and operating problems would have to be considered before propane and butanes would be transported by this system.

No purchase contracts had been signed at the time of the hearing, but Mr. Whiteside stated that Hudson's Bay would purchase pentanes plus from the Pincher Creek-Waterton-Lookout Butte area for $2.40 per barrel f.o.b. at the plant gate and Mr. L. C. Peters, a Vice-President of Continental Oil Company, stated that Continental was prepared to purchase, or provide purchasers for 10,000 barrels per day of condensate at the International border.

4. Trans Mountain Oil Pipe Line

Although given only passing mention at the hearings, the Trans Mountain Oil Pipe Line from Edmonton to the Pacific North-west market area constitutes another possible means of removing pentanes plus and butanes from the Province. All the pentanes plus produced in connection with

the pilot plant operation in the Windfall Field (approximately 2,900 barrels per day during April, 1961) has been moved to market via this line. During April this system was also used to move approximately 3,000 barrels per day of Homeglen-Rimbey condensate to the Pacific Coast to enable prospective purchasers to evaluate the product. Over the past two years shipments of butanes blended with crude oil for use in an Anacortes, Washington, refinery have also been completed successfully.

The Board recognizes, however, that the Western Pacific Products and Crude Oil Pipelines Ltd. 12-inch pipe line presently being constructed between Taylor and Kamloops, British Columbia, may well affect the quantity of Alberta products which will be moved to the Pacific North-west by Trans Mountain. Approximately 500 miles long, this line will deliver crude oil and minor quantities of natural gas liquids from northern British Columbia to Trans Mountain for movement to the West Coast. The product moved by this line will be used by purchasers who might otherwise have used Alberta product and will reduce the Trans Mountain capacity available for movement of Alberta product.

5. Interprovincial-Lakehead-Buckeye

During the reopened Westalta-Foothills hearings Mr. P. J. Perille of Standard stated that interim purchases of natural gas liquids by Tuloma would probably be moved from Edmonton to Port Huron, Michigan, by Interprovincial, from Port Huron to Toledo, Ohio, by existing Lakehead Pipe Line facilities and from Toledo to the Chicago area via the Buckeye Pipe Line system. Although no tariffs for this movement were submitted, Mr. Perille emphasized that Standard believes that the cost of moving the product to the Chicago area by this system would be greater than it would be by the Foothills system and Standard is therefore considering this system only for interim purchases.

The cost views presented by Mr. Perille appear to be well founded since the posted Interprovincial tariff from Edmonton to Toledo is 55 cents per barrel and the Buckeye tariff from Toledo to Chicago is approximately 18 cents per barrel.

A modification of this scheme whereby interim purchases would be moved from Superior to Chicago by tanker was presented by Mr. Lynch of Canadian Bechtel Limited while testifying on behalf of Interprovincial at the reopened hearings. No

tanker rates were presented in support of this proposal.

6. Trans-Canada

While cross-examining on behalf of Trans-Canada at one of the initial Westalta and Foothills hearing Mr. McNeill suggested the possibility of utilizing the Trans-Canada line to move Alberta's surplus LPG to markets in Eastern Canada and stated that his company had been investigating this possibility for some time. The Board has, however, received no formal submission from Trans-Canada concerning the movement of LPG products by this means and further points out that all permits authorizing Trans-Canada to remove gas from the Province of Alberta contain a clause which states that the Board may require the extraction of any substance or substances except methane from any gas before it is removed or caused to be removed from the Province pursuant to the permits.

Removal by Truck and Tank Car

Alternate means of transporting surplus propane and butanes include movement by trucks and tank cars.

The approximate cost of shipping by truck is estimated by propane distributors to be between 1.0 and 1.5 cents per gallon per 100 miles. Using this yardstick, economic truck movement would be limited to the peripheral areas in

Saskatchewan, British Columbia and Montana.

Rail car shipments to distant markets are more economical than truck, and such shipments can be extended to Canadian points from Vancouver Island to Western Ontario and in the United States from Washington and Oregon to Wisconsin. Gas plant operators have indicated that rail charges to the Vancouver area are in the order of 7 cents per gallon. The B. C. Research Council, in its marketing study prepared in conjunction with Dr. Harries' work, indicated that existing rail rates would limit the movement to markets on the West Coast of substantial quantities of propane. The Board feels that this is a reasonable statement and would generally concur with this conclusion.

Normal butane and iso-butane have been shipped by rail to refineries in the Puget Sound area and to natural gas utility companies in British Columbia and the Pacific North-west for peak shaving purposes.

Alberta propane can be shipped into the central and eastern areas of Saskatchewan for approximately 5½ to 7 cents per gallon. Transportation charges of this magnitude considerably reduce the competitive position of propane with respect to other fuels. Propane from both refinery and gas plant sources in Saskatchewan offers additional competition to Alberta propane. However, despite these disadvantages the market for propane from Alberta sources is expected to grow steadily.

The development of markets in Manitoba and Ontario for Alberta propane will also be severely limited by the high cost of moving propane to these markets by existing means of transportation.

There appears to be little demand in Saskatchewan and Manitoba for Alberta butanes at the present time and prospects are not encouraging for the development of substantial markets in this area.

Alberta propane will have considerable difficulty in gaining markets in Minnesota and Wisconsin where a substantial demand exists for this product in rural areas. The Mid-America Pipeline, which handles LPG's, terminates in these two states and a second LPG line has been proposed to carry LPG's into this same general area from Kansas. Such low cost pipe line transportation will also tend to limit the development of potential markets in North and South Dakota for Alberta propane.

VIEWS OF THE INTERVENERS CONCERNING THE ALTERNATE MEANS

Each alternate means of removing natural gas liquids from Alberta was recommended by a company or group of companies who appeared as either an applicant or an intervener, at one or more of the hearings. Westalta and Foothills appeared as interveners at all the hearings at which the alternate proposals were submitted and pointed out that, with the exception of Trans-Canada,

the alternate means made no provision for the movement of Alberta's surplus propane and little provision for the surplus butanes.

Westalta and Foothills pointed out at the Hudson's Bay hearing that 67 per cent of the Hudson's Bay stock is owned by the Continental Oil Company and that approval of the Hudson's Bay scheme would result in Canadian natural gas liquids being exported from Canada by a company which was controlled by an American company. They also suggested that the market for pentanes plus in the Wyoming area is limited and that much of the pentanes plus moved by this system would ultimately have to be moved to the Chicago area by means of the Platte Pipe Line System.

The Interprovincial scheme was opposed by Westalta and Foothills on the grounds that:

1. The submitted capital cost of the Interprovincial line from Superior to Chicago ($23,500,000) should have been 30 to 35 million dollars.
2. The tariffs reflected subsidization of the proposed liquid line by the existing crude oil facilities.
3. The reduction in crude oil tariffs from Edmonton to Superior (44 cents per barrel to 37 cents per barrel) instituted shortly after the original Westalta and Foothills hearings

was effected to meet competition from the Foothills project, rather than to meet competition from other sources as claimed by Interprovincial.

Hydrocarbons did not support the Hudson's Bay proposal but indicated that the Hudson's Bay project would not be opposed if liquids from the Pincher Creek Waterton-Lookout Butte area surplus to the Hudson's Bay proposal were made available to Hydrocarbons at Calgary for movement through the Hydrocarbons system.

The concept of transporting pentanes plus to distant markets by existing interprovincial lines was generally supported by all interveners except Westalta and Foothills.

VIEWS OF THE BOARD CONCERNING THE ALTERNATE MEANS

The Board has examined the tariffs submitted by the supporters of the Interprovincial-Mid-America, Interprovincial, and Hudson's Bay proposals to remove natural gas liquids from the Province and finds that only the tariff calculations submitted by Interprovincial-Mid-America are based on volumes which the Board considers reasonable and show sufficient detail to permit proper evaluation. The Hudson's Bay tariff calculations present adequate detail but are based on greater volumes than the Board believes will be available for movement. No calculations were submitted in support of the competitive Interprovincial tariff, but

the throughput volumes upon which it is based are considered to be reasonable. The Board's forecast of the maximum volume of natural gas liquids which will be available for removal from the Province under conditions of increased economic incentive, are presented in Appendix E in Table E-2.

Hudson's Bay

Due to the location of the Pincher Creek, Waterton, and Lookout Butte fields with respect to condensate markets in Alberta, the Board believes it logical that all condensates produced from these fields be moved to market by the Hudson's Bay line. A comparison of the pentanes plus production forecasts prepared by Hudson's Bay and by the Board is as follows:

	Basic Case Barrels per day		Prospective Case Barrels per day	
Year	Hudson's Bay	Board	Hudson's Bay	Board
1962	11,430	8,480	11,430	8,500
1963	15,810	9,850	15,810	9,900
1964	16,030	9,050	16,030	10,000
1965	16,190	10,990	16,190	12,600
1966	15,680	10,310	19,680	12,600
1967	14,550	9,750	19,750	12,800
1968	13,690	9,320	19,090	13,000
1969	12,760	8,830	21,960	13,200
1970	11,970	8,370	21,870	13,300
1971	11,120	7,810	22,120	13,400

Using the Board's production forecasts and the Hudson's Bay method of calculation the tariffs would be:

	5-year average ¢/barrel	10-year average ¢/barrel
Basic Case	7.8 - 10.0	7.7 - 9.7
Prospective Case	4.7 - 7.0	4.7 - 6.5

These may be compared with the Hudson's Bay proposed tariffs presented on page G-10.

Only the line from Pincher Creek to Cut Bank, however, would be affected directly by this increase in tariffs. Beyond Cut Bank the condensate would be moved by facilities which would also be used for the movement of other products and the effect which this decrease in volume would have on the tariffs of these facilities, although not known to the Board, would not be expected to be as great as it would be on the Hudson's Bay line.

Interprovincial

The tariffs proposed for the natural gas liquid line which Interprovincial proposes to build from Superior to Chicago appear to contain a considerable element of subsidization from existing Interprovincial crude oil transmission facilities.

Using the proposed Interprovincial natural gas liquid tariffs from Edmonton to Chicago and the posted crude oil tariff from Edmonton to Superior the charge for transporting the liquids from Superior to Chicago in cents per

barrel would appear to be

	20,000 bbl/day	50,000 bbl/day
Proposed natural gas liquid tariff	55	44
Posted crude oil tariff from Edmonton to Superior	37	37
Charge for moving liquids from Superior to Chicago	18	7

The posted crude oil tariffs from Edmonton to Superior could be reduced as a result of the additional throughput which the natural gas liquids would provide, but it is unlikely that a reduction of more than 2 to 4 cents would result from an increase in throughput of even 50,000 barrels per day.

These tariffs are considerably lower than the tariff submitted by Mid-America (28 cents per barrel) for a comparable length of pipe line and comparable throughput volumes despite the fact that Mid-America planned to use a 10 3/4-inch line and Interprovincial planned to use a 16-inch line. For the 16-inch line the Board estimates tariffs which would be required to generate sufficient revenue to service the debt and provide a satisfactory return on the capital investment to be:

Throughput bbl/day	5-year Average ¢/bbl	10-year Average ¢/bbl
20,000	66	62
50,000	26	25

These tariff estimates are based on the assumptions that:

1. The cost of the project ($25,400,000) would be composed of $23,500,000 for a pipe line from Superior to Chicago and $1,900,000 for additional storage along the existing Interprovincial line.
2. The project would be financed 75 per cent by debt and 25 per cent by equity.
3. A 9 per cent return per year on the depreciated rate base would keep this portion of line consistent with the existing Interprovincial facilities.
4. Income tax calculations would be based on
   (a) a composite capital cost allowance of 7 per cent applied to the diminishing balance, and
   (b) an income tax rate of 50 per cent applied to the taxable income.
5. A straight line financial depreciation would be calculated at 3.4 per cent per year.

The annual revenue generated by the 18 and 7 cent charges, $1,310,000 and $1,280,000 for throughputs of 20,000 and 50,000 barrels per day respectively, would not, in the Board's opinion, be sufficient to service the debt of the line and provide a return on the company's investment.

The Board is satisfied that the proposed Interprovincial tariffs from Edmonton to Chicago reflect considerable internal subsidization of the proposed line from Superior to Chicago, and expects that any Interprovincial tariff which does not reflect the generation of sufficient revenue to operate the pipe line would be subject to close scrutiny by the National Energy Board.

No tariffs were submitted for movement of the liquids by the Trans Mountain, Interprovincial-Lakehead-Buckeye and Trans-Canada systems.

DISCUSSION

Though the various means of removing natural gas liquids from the Province have been submitted as alternatives to the Foothills proposals none would serve the same function as the Westalta-Foothills-Dakota-Eastern system, i.e. provide a means of transporting all the surplus Alberta propane, butanes and pentanes plus to a market not presently being supplied with Canadian crude oil. Those alternatives using existing crude oil lines and proposed pentanes plus lines provide transportation for pentanes plus and a portion of the butanes but do nothing towards moving the surplus propane. The Trans-Canada line could provide transportation for the surplus propane and some surplus butanes but not for surplus pentanes plus. As a result, none of the alternative means would supply the transportation which Alberta's surplus natural gas liquids will require, but

two or more alternatives combined might be capable of moving all the surpluses. A combination of alternatives would not, however, move all the surpluses to the market which the Westalta-Foothills-Dakota-Eastern system would serve.

THE QUESTION OF THE PUBLIC INTEREST

The Board recognizes the marketing difficulties which will shortly be encountered in connection with the developing surpluses of natural gas liquids and the desirability of establishing markets for these products in areas not now supplied from Alberta. It was evident from the various hearings that the Foothills-Westalta group were among the first, if not the first, to realize the importance of these problems and to attempt to develop a proper scheme to solve them. It also went to considerable expense and effort to conduct geological, engineering and marketing studies of its own. The Foothills-Westalta group developed the possibility of sale of a large volume (up to 75,000 barrels per day) of the products with a major processer-marketer in an area not now served by either gas or oil from Alberta. The Board also observes that the applicant's scheme is the only proposal before it providing a plan for the marketing of all three natural gas liquid products.

Notwithstanding these accomplishments there are three features of the scheme that cause the Board concern

when considering the public interest. These can be summarized as the implication of the proposed Tuloma contract, the potential indirect effect on crude oil markets, and the implication of certain of the ownership arrangements among Pembina, Foothills, Dakota-Eastern and Standard.

The proposed Tuloma contract was strongly opposed by several producers on the following grounds

(a) the term of the contract (20 years), the five-year option at the end of the initial term and the four to five-year grace period before the term became effective,

(b) the basing of the price of pentanes plus on the price of crude oil,

(c) the favoured nations clause in the contract,

(d) the necessity of dedicating to Tuloma quantities of liquids which were 100 per cent in excess of those stated in the original contract, and

(e) the clause giving Tuloma the right to examine the producer's records.

In general the interveners agreed that these provisions would prevent the producer from obtaining the true value of his product. None of the producer-interveners discussed the prices offered by Tuloma for either propane or butane but both Canadian Chemical and C.I.L., indicated these

prices would result in an increase in the price of their feedstock. They concluded that this would be detrimental to the existing petrochemical industry in Alberta and would discourage the establishment of additional plants in the Province.

The Board believes that the prices offered plus the opportunity to contract for a long-term market, would provide sufficient incentive so that some of the producers not now doing so would extract these products from the gas. The Board does not believe that the increased economic incentive would be sufficient to bring about maximum recoveries of the products.

The Board is inclined to agree with the views presented by the producers. In addition the Board believes that the proposed Tuloma contract would, if entered into by producers in Alberta, result in Tuloma and Standard gaining an excessive degree of control and an undesirable domination over the marketing of surplus Alberta natural gas liquids. The Board recognizes that if the surplus liquids predicted by Foothills were correct, then this degree of control would be substantially reduced providing Standard's purchases were restricted to the volumes presented at the hearing.

With respect to the Chicago market itself, the interveners appeared to discredit its potential at the original hearing but in later hearings generally concurred with the applicant in the view that the demand pattern for

petroleum products in the Chicago area is favourable for the use of considerable quantities of pentanes plus and that the refining capacity in the area is adequate to absorb quantities at least as large as those proposed to be purchased by Standard - 75,000 barrels per day. Standard did not provide details of the disposition of propane or butanes but indicated for the latter products that they would be used in gasoline blending, as a raw material for alkylate production, and as a raw material for the petrochemical industry. At the original Westalta hearing Dr. Harries agreed that a large part of the surplus propane could be marketed in the Wisconsin-Minnesota area. However, at the reopened Foothills-Westalta hearing, Dr. Harries indicated that other product lines carrying liquids into this area from the south-central area of the United States would offer serious competition to Alberta propane. Due to this fact, Dr. Harries testified that the propane to be recovered from Alberta liquids would have to be marketed in the area east of Chicago. The interveners raised doubts regarding the markets that would be available to propane shipped from Chicago to the eastern United States.

The Board agrees with the contention of the Foothills-Westalta group and of the interveners that the Chicago market, if it could be reached, would provide an outlet for pentanes plus and butanes. While the Board has certain reservations concerning the future availability of

markets in the Chicago area for large quantities of propane, Tuloma appears willing to accept the responsibility for this up to the volumes included in their proposed purchases.

Notwithstanding the agreement as to the suitability of the Chicago market for most of the natural gas liquids, concern was expressed by the interveners and the Board is inclined to agree, that the effect of introducing large volumes of Alberta natural gas liquids into the Chicago area at this time, might not be desirable from the point of view of the national oil policy and the overall marketing of Alberta crude oil and natural gas liquids. Also referred to at the hearings was the contention that much less resistance to the marketing of Alberta pentanes plus in the United States would be developed if the market for the product were built up gradually from a modest beginning of approximately 10,000 barrels per day. The Board considers this approach to be more in keeping with the public interest at this time.

With respect to the arrangements among Pembina, Westalta, Foothills, Dakota-Eastern and Standard, the Board is concerned about the major role of Standard in the proposed Westalta gathering system. The Board believes it less than desirable in the public interest that Standard who would be a single purchaser-processer-marketer with no direct interest as a producer in the Province, should have the degree of influence which the Board is confident would result. It would appear to the

Board that if an integrated natural gas liquids gathering system in the Province were desirable, the system should be under the complete control of Albertans or Albertan companies.